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NEWS ABOUT THE SOCIETY AND ITS COMMITTEES:

MISCELLANEOUS NEWS NOTES:

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ASTM BULLETIN

"Promotion of Knowledge of Materials of Engineering, and Standardization of Specifications and Methods of Testing"

TELEPHONE—Rittenhouse 6-5315

R. E. Hess, Editor
R. J. Painter, Associate Editor

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Number 157 March, 1949

Numerous Technical Papers at Annual Meeting

A LARGE number of technical papers are in course of acceptance by the Administrative Committee on Papers and Publications, these contributions being scheduled for presentation at the 1949 Annual Meeting at Chalfonte-Haddon Hall, Atlantic City, throughout the week beginning June 27. In addition to the individual papers there are to be several symposiums and special technical sessions.

To give some idea of the subjects which probably will be covered, there are given below two lists, first, the symposiums and special sessions, and second, a tentative list of topics to be covered in technical papers. This list should not be considered as final because there are always certain papers accepted which for good and sufficient reason do not materialize in time for presentation. Also, there are papers which although not presented at the Annual Meeting may be published in the BULLETIN.

ENTERTAINMENT

It is expected that the Philadelphia District through its Council will act as the host during this Annual Meeting, and while no definite decisions have been reached, it is expected the district will sponsor an Annual Meeting Dinner with some outstanding speaker on a pertinent subject, and in conjunction with this there may be other social activities. Whether the Golf Tournament will be reinstituted is now under consideration. Undoubtedly the district will plan some special ladies' features, but further announcement will be made.

SYMPOSIUMS AND SPECIAL SESSIONS

Notes on some of the following symposiums and special sessions have been published in previous BULLETINS, and in the May BULLETIN, which will again carry the Provisional Program for the meeting, there will be a list of the papers comprising these features. While it is confidently expected that all of the subjects listed will materialize, members are urged to check the Provisional Program for later information.

Symposiums and Sessions on:

- Accelerated Durability Tests of Bituminous Materials
- Testing of Cast Iron with SR-4 Type Gage
- Ultra Sonic Testing
- Quick Identification Test
- Relations of Performance of Stainless Steel in Evaluation Tests to Performance in Service
- The Need for Standards for the Examination of Water-Borne Wastes
- Radiography
- Soils

TECHNICAL PAPERS

Among the topics to be covered in the numerous technical papers that are scheduled for presentation are the following:

METALS:

- Influence of Fluctuations in Stress Amplitude on the Fatigue of Metals
- Results of Plant Corrosion Tests of Welded Stainless Steels
- Effect of Manufacturing, Practice on Creep and Creep-Rupture Strength of Low-Carbon Steel
- Surface Preparation and Repainting of Structural Iron and Steel
- Effect of Spray Metallizing Procedure on the Fatigue of Steel
- Fatigue Characteristics (Reversed Bending) of Material from a High-Strength Aluminum Alloy (75S – T6) Plate as Affected by Type of Machine and of Specimen
- Creep and Stress-Rupture Investigation on Some Aluminum Alloy Sheet Metals
- Effect of Weather on the Initial Corrosion Rate of Sheet Zinc
- A New High-Speed Sheet Metal Fatigue Testing Machine for Unsymmetrical Bending Studies
- The Time Delay for the Initiation of Plastic Deformation at Rapidly Applied Constant Stress
- New Equipment for Creep and Rupture Testing of Temperature-Resistant Materials Under Vibrations
- Creep and Rupture Behavior of Five Temperature-Resistant Materials Under Vibratory Tensile Stress

CEMENTITIOUS:

- A Wetting and Drying Test for Predicting Cement—Aggregate Reaction
- The Non-Evaporable Water Content of Hardened Portland Cement Paste—Its Significance for Concrete Research and Its Method of Determination
- The Direct and Continuous Measurement of Bleeding in Portland Cement—Water Mixtures
- Long-Time Tests of Concrete Under Various Storage Conditions
- The Design of Concrete Mixes Containing Entrained Air
- The Use of Natural Anhydrite in Portland Cement
- Engineering Properties of Coral Reef Materials
- The Size and Border Conditions of Test Specimens in Their Relation to Results of Fire Tests

MISCELLANEOUS:

- 20 to 30 Years Weathering of Asphalt Shingles Made with Unfilled Coatings
- Creep Characteristics of Compression Molded Polyethylene
- Flexural Testing of Plastic Materials
- Laboratory Testing of Transformer Oil During Commercial Use
- A Pulsating Load Creep-Rupture Machine

1949 Marburg Lecture on Residual Stresses in Metals

ON WEDNESDAY, June 29, in Atlantic City, Dr. William Marsh Baldwin, Jr., will present the 1949 Edgar Marburg Lecture on the subject, "Re-

W. M. Baldwin, Jr.

sidual Stresses in Metals." In selecting this subject involving stress analysis and the locked-in stresses which may be developed during fabrication and in other ways, the Lecture Committee felt it is extremely timely, and believed that an up-to-date discussion would be of widespread interest.

There are various things which set up residual stresses, and a variety of experimental methods are used to determine type and amount of such stresses. It is expected that the Lecturer will discuss these points, cover the effects of residual stresses, and also point out some methods for their elimination.

Dr. Baldwin, a native of Buffalo, is a graduate of Rensselaer Polytechnic Institute, and later studied in Germany, Switzerland, and Case Institute of Technology. Currently Dr. Baldwin is Research Professor and Director of the Metals Research Laboratory of the Department of Metallurgical Engineering at Case.

Committee on Arrangements Appointed for West Coast Meeting

THE Committee on Arrangements for the first National A.S.T.M. West Coast Meeting has been appointed, the personnel of this group being listed in the accompanying box. This meeting is to be held, as has been announced previously in the BULLETIN, in San Francisco from October 10 to 14, inclusive, with main headquarters at the Hotel Fairmont. A number of technical sessions are being developed and several Society committees will hold meetings during this week.

Local Committee:

It is the usual practice to designate local committees on arrangements when the Society holds some of its national meetings in industrial centers. These groups are responsible for various meeting matters, in particular entertainment, trips scheduled, ladies' entertainment, and such affairs, and the committees are helpful in giving advice and suggestions to the Board of Directors and to the Administrative Committee on Papers and Publications which is responsible for the technical program.

China Town

The local committees are always extremely helpful and cooperative in aiding and advising the headquarters staff on the seemingly infinite number of details that must be cared far.

Although the locale of this first national meeting of the Society west of the Mississippi is to be San Francisco, and the officers of the Northern California District centered in that city have been sparkplugging plans thus far, with Dozier Finley, the District Chairman, directing much of the advance planning from the local standpoint, the meeting is to be truly a western meeting, and hence there are representatives on the Committee on Arrangements from various industrial areas in both the West Coast states and some of the Rocky Mountain states.

President R. L. Templin and Executive Secretary C. L. Warwick are spending some time during March on the Coast speaking at technical meetings in Los Angeles and San Francisco, and the Executive Secretary particularly is having numerous conferences in San Francisco in connection with the October National Meeting.

Technical Program:

As noted in previous BULLETINS, there will be technical sessions at this meeting devoted to varied problems and materials such as statistics, ceramics, concrete products, creep and fatigue of metals, paints, petroleum products, soils, wood, and others. A Committee on Technical Program has been functioning under the chairmanship of Professor R. E. Davis, University of California at Berkeley, with Professor J. W. Kelly, also at Berkeley, as Secretary.

While it is expected there will be a number of innovations in connection with the social and entertainment aspects of the meeting, the technical program is being developed with the same care and thought that goes into any national meeting of the Society. Outstanding leaders are being invited to present technical papers, and the technical sessions will be in keeping with the reputation which the Society has established as an important form for the presentation and dissemination of authoritative data on the properties and tests of materials.

Technical Committees to Meet:

Communications have been directed to all of the A.S.T.M. technical committees inviting them to hold meetings on the West Coast. A number of these groups have already taken action and others are still considering the matter.

National Parks—Scenic Wonders

ONE does not think of the West without also thinking of the great national parks which extend over vast areas of its terrain—a panorama of scenery magnificent and often breath-

Committee on Arrangements for West Coast Meeting

DOZIER FINLEY, Research Consultant, The Paraffine Cos., Inc., 2725 Ashby Place, Berkeley 5, Calif. (*Chairman*)

R. F. BLANKS, Engineering Control and Research, U. S. Bureau of Reclamation, Denver Federal Center, Denver, Colo.

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W. C. HANNA, Chief Chemist, California Portland Cement Co., Colton, Calif.

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taking. In fact, in instances, there is no equal to it throughout the entire world.

The simple facts are these:

Some travelers believe that the Swiss Alps, except for several unmatchable features, are excelled in beauty and variety by several of our parks, and these parks have certain distinguished features unrepresented in the splendor of the Alps.

Other travelers say the Canadian Rockies are matched in rich coloring by our Glacier National Park.

The Yellowstone outranks any similar volcanic area in the world and is said to contain more geysers than the rest of the world together. The famous canyon is unique in its quality of beauty. Except for portions of the African jungle, Yellowstone is probably the most populated wild animal area in the world.

Mount Rainier has a single-peak glacier system whose equal is yet undiscovered. Twenty-eight living glaciers spread octopus-like from its center.

Crater Lake is the deepest and bluest accessible lake in the world, occupying the hole left after one of the largest volcanoes had slipped back into earth's interior through its own rim.

Yosemite possesses a valley whose compelling beauty is acknowledged as supreme, the valley being the center of eleven hundred square miles of high altitude wilderness.

The Sequoia, a beautiful, restful area, contains more than a million sequoia trees, twelve thousand being more than ten feet in diameter. Some are the largest and oldest of living things on earth.

The Grand Canyon of Arizona is the hugest and most breath-taking example of erosion known to mankind. The finest of its carvings and color seem to be the work of the Great Architect. Zion and Bryce, younger than Grand Canyon by several million years, each has unique and breath-taking features which repay a visit from any distance.

In these parks the visitor finds enjoyment and inspiration, and gains a true realization of how richly endowed is our country, for here are the museums of the ages. The West is indeed the "Golden West" not only because of the ore obtained from the depths of its earth, but because of the more precious "gold" one finds in its scenic wonders.

Western Members to Receive Personnel Data

So THAT the Local Committee on Arrangements for the West Coast Meeting would have a list of all the A.S.T.M. members and committee members in the Rocky Mountain and Pacific Coast states, a special list has been prepared, and since this rather complete information would be of interest and service in connection with A.S.T.M. activities, a copy is being sent with an appropriate covering letter from the Executive Secretary to the some 550 men who are affiliated with A.S.T.M. in the following states: Arizona, California, Colorado, Idaho, Montana, Nevada, New Mexico, Oregon, Utah, Washington, and Wyoming.

This special list gives the names, titles, and addresses of all members and committee members in these eleven states. The A.S.T.M. Year Book does give a list of names of individuals and company members in accordance with geographical distribution, but for activities in connection with the first West Coast National Meeting to be held the week of October 10, in San Francisco, and for other A.S.T.M. activities, this special list with complete information has been issued.

Symposium on Aging of Rubbers Features Spring Meeting

Six Technical Papers Presented; 250 in Session

THE great interest in the subject of aging and deterioration of rubbers was readily apparent from the large audience which attended the symposium in Chicago on Wednesday, March 2. Many comments were heard on the excellence of the six technical papers comprising the symposium, the titles and authors of these being noted below.

There were over 250 at the session, and the officers in charge of the symposium and the Society officers are pleased at the successful outcome of this technical feature.

Another feature of the Spring Meeting was the dinner sponsored by the Chicago District. This was preceded by a cocktail hour, and following the dinner there was an interesting program of entertainment. The New Trier High School Glee Club and a Cappella Choir received a tremendous ovation at the close of its program. There were songs by the whole group, and then by the young women and the young men separately. Both groups gave excellent performances.

The unusual colored motion pictures of "Flowers in Action," by John Nash Ott, Jr., also were very favorably received. The whole affair, beginning with the cocktail hour through the entertainment, was very well planned. The hotel also added to the occasion with an excellent meal and good service.

Compliments to:

The authors of the technical papers in the symposium should, of course, receive a "Thank you" for their excellent efforts. Abstracts of their contributions appear below, and the papers are to be issued as a special publication later in the spring. G. C. Maassen, R. T. Vanderbilt & Co., Inc., who headed the Symposium Committee in Technical Committee D-11 on Rubber and Rubber-like Materials, should receive much credit for the excellent result. Cooperating closely with him were the Committee D-11 officers: Chairman Simon Collier, Johns-Manville Corp., and D-11 Secretary and A.S.T.M. Past-President Arthur W. Carpenter, of the B. F. Goodrich Co.

For the Chicago District, a group of five, working closely as a good team, directed the successful dinner and its features should receive full credit for their important part in the Spring Meeting. The Chicago District officers, Chairman J. J. Kanter of the Crane Co., Secretary G. E. Stryker of the Bell & Howell Co., and Vice-Chairman J. deN. Macomb, now retired, had the close cooperation and intensive efforts of W. L. Bowler, Pure Oil Co., and D. L. Colwell, Apex Smelting Co. Several meetings of this group had been held earlier, and they carried through effectively.

The entertainment features of the meeting aside from the dinner were underwritten by the Chicago District through the fine support it received from a number of the A.S.T.M. Company and Sustaining Members.

Symposium on Aging of Rubbers

FOLLOWING the formal opening of the Spring Meeting by President Templin, who complimented Committee D-11 on its intensive work, the Technical Chairman, G. C. Maassen,

presented by session chairman. Simon Collier introduced the various speakers and directed discussion following the papers.

Synopses of the papers are presented below. The complete manuscripts will be edited shortly and published as soon as possible in a special technical publication. Members and committee members will be advised when this book is available but the plans are to get it completed in the next few months. The subject is an important one and the information given by the authors is considered very timely and should be of widespread interest.

Mode of Attack of Oxygen on Rubber

A. M. Neal and J. R. Vincent

It has long been recognized that rubber, because of its unsaturation, is degraded by atmospheric oxygen, and, in contrast with most unsaturated materials, a very small degree of oxidation is sufficient to destroy its characteristic properties.

The oxidation of rubber, whether vulcanized or unvulcanized, is a complicated process, involving several reactions, each of which is influenced differently by conditions. The existence of more than one reaction is illustrated by reference to the influence of: (1) a given material on raw and vulcanized rubber; (2) chemicals on mill breakdown; (3) different antioxidants in an otherwise similar stock; (4) combinations of metal catalysts; (5) oxygen pressure on the temperature coefficient of the oxidation; (6) temperature on the amount of oxygen required for degradation; and (7) different aging conditions.

Oxygen-Absorption Methods—Their Utility and Limitations in the Study of Aging

J. Reid Shelton

The three methods commonly employed for oxygen-absorption studied (namely, gravimetric, manometric, and volumetric) are briefly reviewed and compared. Illustrative examples of the use of the volumetric method for the study of aging are presented.

The limitations of the method are said to be no more numerous or serious than those of other aging tests. The data are shown to be reproducible and to correlate with changes on physical properties. It is recommended, however, that the data be used in conjunction with other aging tests and not as the only criteria of aging resistance.

Oxygen-absorption methods are said to offer great promise for continued use in the study of aging, and also for possible use as a test for predicting the probable relative resistance to aging in service.

Chemical Changes in Elastomers and Antioxidants During Aging

John O. Cole

While the marked changes in physical properties of elastomers which occur during aging are well recognized, until recently very little was known concerning the nature of the chemical changes. The object of this paper is to review the present status of knowledge concerning the chemical changes which occur in elastomers and antioxidants during thermal and photochemical oxidation.

Since definite conclusions are difficult or impossible to obtain by direct experimentation with polymers, indirect methods involving study of low molecular weight hydrocarbons are often used. The best approach to the problem appears to involve investigation of the oxidation products of low molecular weight olefins closely related to the polymer in chemical structure. Beginning with a simple olefin, the effect on the nature of the oxidation products produced by increasing the size and complexity of the molecule is determined. On the basis of such data and reasoning by analogy the reactions most likely to occur in the polymer are deduced. This method of approach is illustrated by reviewing the work of Farmer and his coworkers on the oxidation of cyclohexene, methyl cyclohexene, methyl oleate, low molecular weight polyisoprenes of the type $H(CH_2—C(CH_3)=CH—CH_2)_nH$ $n = 2, 3,$ and 6 and unvulcanized natural rubber.

Of the experimental methods applicable to direct study of polymer oxidation products infrared methods are among the most promising. The infrared absorption spectra of elastomers undergo marked changes as the result of oxidation. The interpretation of these changes is discussed and it is shown that C=O, O—H, and C—O groups are formed as the result of oxidation. The gradual saturation of double bonds is also shown.

Antioxidant consumption during natural and artificial aging is demonstrated by analytical methods. With aromatic amines the secondary amine group is destroyed during aging and part of the antioxidant appears to combine with the polymer.

Physical Aspects of the Aging of Rubbers

M. C. Throdahl

Within the past ten years the general trends of theory and experimental evidence suggest that aging or degradation is quite like polymerization in nature. These reactions are chain mechanisms; the physical changes of which are the net sum of several simultaneous processes: (*a*) cross linking, cyclization, and continued polymerization which harden and stiffen the rubbers, and (*b*) scission which produces tackiness in the rubbers and results in loss of tensile strength. The relative degree to which different rubbers are susceptible to these mechanisms were discussed.

Several physical methods are available for isolating and measuring the relative rate of one or both of the cross linking and scission reactions. Among these the uses of viscosity, sol-gel relationships, stress relaxation, creep and permanent methods for measuring the oxidation effects in various rubbers were described and interpreted.

Effects of Light and Ozone on Rubber

John T. Blake

It can be stated that the action of light and ozone on rubber is manifested in a variety of ways. Light can apparently depolymerize rubber, it can bring about its vulcanization either in the presence or absence or vulcanizing agents, and it can catalyze the oxidation of both raw and vulcanized rubber. The activation of the oxidation of unvulcanized raw rubber by light is susceptible to catalysis, both positive and negative, by various organic chemicals. Their action bears little relation to and may be opposite from the effect of these materials on the oxidation of vulcanized rubber in the dark. Light-catalyzed oxidation is largely a surface effect in contrast to that in the standard accelerated oxidation tests which are largely a bulk affair.

The cracking of statically and dynamically stressed rubber seems to be due not to the direct action of light, but to dilute ozone generated in the atmosphere by sunlight. It is, therefore, closely related to the cracking of stressed rubber in dilute ozone, and the mechanism of each is probably identical with that of cracking in concentrated ozone. Frosting and atmospheric and dilute ozone cracking can be controlled by various organic chemicals or suitable protective coatings. On the other hand, these devices do not stop the cracking of rubber in more concentrated ozone. Protection in this case is obtained by developing rubber compounds which relax physically after stretching or by producing rubber-like materials which have no chemical double bonds to react with ozone. The cutting of stressed rubber by electrical discharge can be due to ozone generated thereby, and, in addition, perhaps may be caused by electron bombardment.

The Effect of Temperature on the Air Aging of Rubber Vulcanizates

M. G. Schoch, Jr., and A. E. Juve

The purpose of this report is to show the effect of the temperature of exposure in an air aging test on the rate of deterioration of the properties of typical vulcanizates of natural rubber, GR-S, GR-I, nitril rubber, and Neoprene.

The results show that over the temperature range of 70 C. to 125 C. the rate of deterioration is dependent on temperature and the temperature coefficient of aging varies between 1.82 and 2.87 per 10 deg. C. depending on the composition of the material and the property being measured.

The nature of the deterioration in all materials tested is the same over this temperature range except for those materials which develop a nonhomogeneous cross-section during aging. Above 125 C. all the materials tested appeared to undergo a different kind of deterioration.

The test-tube method of air aging was found to be approximately equal in severity to the oven method and appreciably more reproducible between laboratories.

1100 Technical Men Attend A.S.T.M. Committee Week, Chicago, February 28-March 4

Many New Standards Completed, New Research on Materials Undertaken

MANY new specifications and tests for materials and numerous revisions were completed during A.S.T.M. Committee Week in Chicago beginning February 28, and much new research work was discussed at the 300 meetings of the Society's technical committees. A large number of meetings are concentrated during this week so that the committee members can attend the various committee meetings with considerable saving of time and expense. This year the registration total was over 1100, but this figure varies f year to year depending upon the number of committees which meet.

Most of the new and revised standards completed at the meeting are subject to letter-ballot in the committees before they are referred to the parent Society for action. Most of the new specifications will be considered finally at the A.S.T.M. Annual Meeting in Atlantic City during the week of June 27, although some may be approved prior to the meeting then through the Administrative Committee on Standards which can act for the Society in deciding whether a consensus has been reached in the technical groups.

A list of the major committees which met in Chicago follows, and most of these had numerous subcommittee and section meetings.

List of Committee Meetings

- A-1 on Steel (Pittsburgh)
- A-3 on Cast Iron
- A-5 on Corrosion of Iron and Steel
- A-10 on Iron-Chromium, Iron-Chromium-Nickel and Related Alloys
- B-3 on Corrosion of Non-Ferrous Metals and Alloys
- B-4 on Electrical Heating Resistance, and Related Alloys (Philadelphia)
- B-6 on Die Cast Metals and Alloys.
- B-7 on Light Metals and Alloys, Cast and Wrought
- B-8 on Electrodeposited Metallic Coatings
- C-1 on Cement
- C-2 on Magnesium Oxychloride Cements
- C-8 on Refractories
- C-9 on Concrete and Concrete Aggregates
- C-15 on Manufactured Masonry Units
- C-16 on Thermal Insulating Materials
- C-17 on Asbestos-Cement Products
- C-19 on Structural Sandwich Constructions
- D-1 on Paint, Varnish, Lacquer, and Related Products
- D-2 on Petroleum Products and Lubricants (Washington)
- D-4 on Road and Paving Materials
- D-5 on Coal and Coke
- D-8 on Bituminous Waterproofing and Roofing Materials
- D-11 on Rubber and Rubber-Like Materials
- D-15 on Engine Antifreezes (Washington)
- D-19 on Industrial Waters
- E-1 on Methods of Testing
- E-3 on Chemical Analysis of Metals (Pittsburgh)
- E-4 on Metallography
- E-6 on Methods of Testing Building Constructions
- E-9 on Fatigue
- E-12 on Appearance

Practically every one of the committee meetings was well attended by representatives of both consumers and producers of the materials involved.

In line with the usual practice of requesting officers of the technical committees to supply information on the major developments at the committee meetings to be used as the basis for news accounts in the BULLETIN, there appears on the following pages information which it is believed will be of interest to many of the members. There was intensive activity at all of the meetings and a review of the developments as indicated below will make clear to those concerned just how much activity is under way in the fields of standardization and research. These accounts cover not only meetings held in Chicago during Committee Week but several groups which have met recently in other cities.

While a sincere effort has been made to get statements in the BULLETIN relating to most of the committees which met in Chicago, it has not been possible to cover all of them. In order to get the March BULLETIN published and in the mails reasonably close to the scheduled time, some committee statements had to be omitted.

Letter-Ballots:

For the most part all of the recommendations noted will be referred to the various committees for letter-ballot before formal recommendation to the Society and this situation should be kept in mind in reviewing the proposed actions. Members will be given further information through the preprints of reports which will be distributed this year, as previously, in advance of the annual meeting, these reports covering the many actions which committees will bring up at the Annual Meeting in Atlantic City, June 27–July 1.

Committee A-1 on Steel (Pittsburgh, January 24 to 26)

THE keynote at the meeting of the Committee A-1 on Steel during its three-day session in Pittsburgh, January 24–26, was a review of existing specifications to bring them up to date. This involved consideration of requirements of other bodies such as the A.A.R., A.R.E.A., and the A.I.S.I., as well as rearrangement of requirements in existing documents to bring them more in line with present commercial practice. Work on several new specifications and methods is also well under way.

Committee A-1 on Steel did not participate in A.S.T.M. Committee Week during the first week in March in Chicago, but held some 20 meetings of subcommittees, task groups, and the main group in Pittsburgh.

In the field of steel rails and accessories such as joint bars, spikes, and bolts and nuts, all of the A.S.T.M. specifications are being brought into complete agreement with the parallel A.R.E.A. specifications. An exception is the Standard Specification for Open-Hearth Carbon-Steel Rails (A 1), which has no counterpart in the A.R.E.A. and is now being recognized by the A.S.T.M. as intended primarily for industrial and export use.

The subcommittee concerned with structural steel for bridges and buildings has revised most of the specifications for structural steel to present them in what it feels is a more useful form. In this revision a product specification, i.e., bridge steel, is a very compact document covering only chemistry, physicals and other such essential items, with reference made to a new general specification (A 6) for requirements applicable to all the structural steels. The general specification includes a

FOR NEWS OF NEW TECHNICAL COMMITTEES ON PORCELAIN ENAMELS, FLOOR WAX, GRAPHITE, CERAMIC WHITEWARES, AND OTHERS, SEE p. 28.

large number of tolerance tables and related material. These proposals are now subject to approval by the Society.

The subcommittee on steel for boilers and pressure vessels has been given the necessary clearance to revise its specifications along the general lines as has been done for structural steel and the work is well under way. Revisions are contemplated for Specifications A 31 for Boiler Rivet Steel and Rivets to bring the requirements into line with latest commercial practice.

It is proposed to cancel the present Specifications A 14 for Carbon Steel Bars for Springs since this composition has been replaced in general use by that covered in Specifications A 68. Along these lines, since A 68 is in general use the word "special" is to be dropped from its title which will now read "Carbon-Steel Bars for Springs with Silicon Requirements." The present steels covered by Specifications A 68, A 59 for Silicon Manganese Steel Bars for Springs, and A 60 for Chromium Vanadium Steel Bars for Springs are being brought into conformity with latest manufacturing practice. The reference to "crucible process" is also being dropped from these three specifications since the steel is no longer made commercially. Work is under way on drafting a specification covering A.I.S.I. composition 8655 for spring steels.

In the field of forgings, 13 specifications are being brought up to date and quite extensive revisions have been completed. These specifications cover forgings for railroad and industrial uses, ring and disk forgings, seamless drum forgings, and forgings for turbines.

The subcommittee on bar steels is continuing its intensive work on up-to-date and complete coverage of the field. It is proposed to cover eight grades of material in the Tentative Specifications for Carbon Steel Bars Subject to Mechanical Properties (A 306) which now includes only three grades. The Tentative Specifications for Cold Finished Carbon Steel Bars and Shafting is being revised by bringing the various grades covered up to date. The subcommittee has also recognized the need for a document covering definitions and procedures for testing bars and has one under preparation.

A specification consolidating the essential grades found in the present Specifications A 157 for Alloy-Steel Castings for Valves, Flanges, and Fittings, for High-Temperature Service and A 217 for Alloy-Steel Castings Suitable for Fusion Welding for High-Temperature Service is well under way. When this is adopted it is expected to supersede Specifications A 157 and A 217. Various revisions are contemplated for Specifications A 182 covering steel for high-temperature piping accessories, including revised chemistry and physicals for grade F22 and clearer definition of the various heat treatments given the austenitic steels. Specification A 181 for Forged or Rolled Steel Pipe Flanges for General Service is being expanded to cover forged fittings and valves and parts. Progress is being made on the development of a specification for forgings for low-temperature service. Agreement has been reached on a proposed specification for carbon, ferritic and austenitic steel pipe and tubing for low temperature service and final action on adoption is being started.

A special group has been established to correlate the grade numbers for the several types of steel common to the various commodities under the jurisdiction of the subcommittees on steel tubing and pipe and material for high-temperature use.

Committee A-3 on Cast Iron

Subcommittee XIX on Chilled and White Iron Castings was reactivated with G. L. Richter appointed as the new chairman.

The specification on pig iron (A 43) was carefully reviewed and recommended to be continued as tentative. Simplification of the grades is contemplated and extension of the silicon ranges for silvery iron.

The Subcommittee on General Castings, arranged for data on Brinell-Tensile strength relationship in the form of a chart to be added to the specifications for gray iron castings (A 48). A study and critical review of the test bar technique for the transverse test were scheduled as a future activity.

There was a review of extensive impact test studies recently completed and plans were approved for publication of this information on the various test methods in the annual Committee A-3 report. This should offer very interesting data on impact test methods for cast iron.

The Committee has scheduled further cooperative tests to accumulate data on the various individual test methods and machines with the view eventually of developing a tentative specification. The Charpy and the British Izod single blow test and the repeated drop test will be further correlated.

For the Research Committee, J. S. Vanick reported completion of the extensive technical program on the stress-strain testing of cast iron to be presented at the 1949 Annual A.S.T.M. Meeting in Atlantic City beginning June 27. Fourteen individual contributors have prepared the papers and an interesting discussion on this new testing technique is promised.

Committee A-3 proposes to sponsor a symposium on the properties, testing, and use of cast iron for presentation at the San Francisco meeting to be held in October. The authors and subjects were outlined in considerable detail.

Committee A-5 on Corrosion of Iron and Steel

The Subcommittee on Methods of Testing recommended a revision in the definition of end point for the Preece Test, recognizing both exposure of basis metal as well as a deposit of copper as the "end point." In addition, the subcommittee is studying new methods for stripping zinc and terne plate coatings to determine thickness.

A revision in two specifications, one on galvanized zinc-coated iron or steel sheets (A 93) and the other on long terne iron or steel sheets (A 309), to include sheets coated in coils was studied by the subcommittee on sheet specifications.

The Wire Specifications Subcommittee is planning revisions of the specifications for Farm-Field and Railroad Right-of-Way Fencing and Barbed Wire separating the first-mentioned into two new specifications: one for Farm Fence and the other for Railroad Right-of-Way work. The subcommittee section on Telegraph and Telephone Line-wire has prepared a new specification for high-strength wire.

The subcommittee on hardware specifications recommended that the specification on hot-dip zinc-coated iron and steel hardware (A 153) be advanced to standard after the "embrittlement clause" was made to agree with that of the standard on hot-galvanized zinc-coated structural steel shapes, plates and bars, and their products (A 123).

Corrosion inspections will be made in the future on an annual basis rather than semi-annually as has been done heretofore by the subcommittees on sheet and wire testing. Due to changed conditions, the Brunot Island site must be abandoned in the near future. It was decided to remove all specimens from the site after the 1951 inspection, relocating only wire specimens of a special nature.

Committee A-10 on Iron-Chromium-Nickel and Related Alloys

Although the Subcommittee on Classification of Data held no formal meeting, it reported that all the revised material for the A-10 Data on both Cast and Wrought Alloys was now in hand and will be ready for publication soon.

The Subcommittee on Methods of Corrosion Testing has now completed its program for atmospheric exposure testing. It is starting to assemble test specimens to be exposed in the near future at a number of test sites which the Advisory Committee on Corrosion is establishing for the Society. Plans are also complete for the Symposium on the Relations of Performance of Stainless Steel in Evaluation Tests to Performance in Service which the committee is sponsoring at the annual meeting in June.

The Subcommittee on Mechanical Test Methods reported the completion of the fourth series of round-robin tension testing in which particular attention was given to the need for the maintenance of an extremely uniform temperature during testing.

The Subcommittee on Specifications for Flat Products considered the request of the Boiler Code Committee to add some new grades of corrosion-resistant steel. It was agreed that two grades could be added now but that further information on Boiler Code Committee requirements was needed before action could be taken on the other grades requested.

The Subcommittee on Specifications for Castings effected final reconciliation be-

tween Specifications for Corrosion-Resistant (A 296) and Heat-Resistant (A 297) Iron-Chromium and Iron-Chromium-Nickel Alloy Castings for General Application and the alloy composition limits published by the Alloy Castings Institute. The matter of a uniform alloy designating system was discussed and steps taken to coordinate actions with Committee A-1 on Steel and Committee B-4 on Electrical Heating, Resistance, and Related Alloys.

Committee B-3 on Corrosion of Non-Ferrous Metals and Alloys

Committee B-3 reviewed a number of its current test programs, and considered the status of certain of the testing methods in its charge. This committee has a record of outstanding contributions through the important data it has developed as a result of a great many years of atmospheric and other types of exposure testing.

The Subcommittee on Spray Test is recommending minor changes in the Method of Salt Spray (Fog) Testing (B 117) to improve the control of testing conditions and to make the method applicable for painted panels. The subcommittee is making studies of the acetic acid-salt spray test for plated die-castings and on the effect of various concentrations of salt solution.

The Subcommittee on Weather reported that immediately after the meeting last spring they had prepared and exposed "pilot" test samples at a number of test locations to study the relative corrosiveness of various atmospheres. These have now been exposed for nearly a year and O. B. Ellis who is in charge of this program will prepare a paper on Factors in Measuring the Corrosiveness of the Atmosphere to be appended to the annual report of the committee.

The Subcommittee on Galvanic and Electrolytic Corrosion reported that the disk samples with the aluminum and magnesium couples will be exposed at several locations early this summer.

Committee B-6 on Die-Cast Metals and Alloys

The Subcommittee of Zinc-base Alloy Die-castings completed for committee letter-ballot the draft of a proposed specification for zinc base die-casting alloy ingot. The preparation of this specification has presented some difficult problems.

The Subcommittee on Exposure and Corrosion Tests arranged to bring in from the various atmospheric test sites specimens which have now been exposed for ten years. Plans were made for the necessary examination and testing to evaluate the results obtained in this series of tests.

The Subcommittee on Die-Casting Processes had presented two reports which were discussed during the meeting; one of these was on Methods of Measuring Die Temperature, the other on Die Cavity Filling. It was felt that both reports will be very helpful to the committee in its work.

Committee B-7 on Light Metals and Alloys

After further study of proposals advanced by Frankford Arsenal and others, it appears that A.S.T.M. Committee B-7 on Light Metals and Alloys may be able to eliminate small differences now existing in type of code designations applied to aluminum and to magnesium alloys. These matters were discussed during A.S.T.M. Committee Week in Chicago. The committee aims to arrive at a code which will be logical and easy to apply and also will have a maximum of flexibility.

The committee reviewed almost all of its magnesium specifications and eliminated one sheet and three casting alloys which are no longer in commercial production and added one new casting alloy.

The committee reviewed a proposal to remove from its individual specifications requirements for sampling and testing and to write them into a new separate recommended practice.

A review of all of the committee's specifications for wrought aluminum products is in process and some changes will be submitted to letter-ballot prior to the A.S.T.M. Annual Meeting in June.

The special subcommittee on the corrosion test program made a final review of the program agreeing on details as to the alloys to be included, the temper of each to be tested, the types of specimens to be used, and the test sites to be employed.

Committee B-8 on Electrodeposited Metallic Coatings

Committee B-8 voted to recommend the adoption of the recommended practices for Chromium Plating on Steel (B 177) and on Preparation of Low-Carbon Steel for Electroplating (B 183). A new recommended practice for Preparation of High-Carbon Steel for Electroplating will be recommended as tentative. The specifications for Electrodeposited Platings of Zinc (A 164) and Cadmium (A 165) on Steel are being amended and retained as tentative. The same action was taken in the specification for Chromate Finishes on Electrodeposited Zinc, Hot-dipped galvanized, and Zinc Die-cast Surfaces (B 201).

During the meeting, H. A. Pray of Battelle Memorial Institute presented, on behalf of the Subcommittee on Performance Tests, a report on Atmospheric Exposure of Electroplated Coatings on Steel. This was discussed by the committee and will be appended to the committee's annual report.

Considerable activity was also noted by the Subcommittees on Conformance Tests, Electroplating Practice and on Supplementary Treatments for Metallic Coatings. At the meeting of the last-named subcommittee, representatives of the Navy Department and of the American Society of Refrigerating Engineers presented special problems on which help of the committee was solicited. In both cases, steps were taken to initiate work expected to help find an answer to these problems.

Metal Powders and Metal Powder Products

At the meetings of Committee B-9 on Metal Powders and Metal Powder Products and its various subcommittees in Pittsburgh, Pa., on January 31 and February 1, Subcommittee I on Nomenclature and Technical Data devoted its principal attention to a discussion of the Glossary of Terms Used in Powder Metallurgy. This Glossary had previously been approved, but some of the definitions required reconsideration in the light of comments by Committee E-8 on Nomenclature and Definitions. Subcommittee I also reviewed work done toward the development of a standard test bar design for use in powder metallurgy work. Blueprints of the dies used for pressing this bar will be circularized among those in the metal powder field who have contributed toward this development, and comments relative to its use will be solicited.

Subcommittee II on Metal Powders discussed the results of a test program undertaken to find the best method of determining the compressibility of metal powders. A paper on this subject by F. V. Lenel, entitled "A Compressibility Test for Metal Powders," appears in this BULLETIN. Test methods for the determination of the "hydrogen loss" and "per cent insolubles" of metal powders were discussed and it was noted that standards on these methods developed by the Metal Powder Association should be submitted to the subcommittee for ballot and then to Committee E-3 on Chemical Analysis of Metals.

All of the sections of Subcommittee III on Metal Powder Products met and the following business was transacted:

III-A on Bearings: Changes in the Tentative Specifications for Metal Powder Sintered Bearings (B 202 – 45 T) were discussed, and it was proposed that some adjustment of chemical and density tolerances are in order in view of recent experience. A tentative list of desirable press fits for various sizes of bearings was also approved in essence.

III-B on Cemented Carbides: Task groups to propose test methods for the determination of hardness measurement, transverse bend strength, microstructure, and a chart of comparative grades were established. These groups will investigate existing methods of testing carbides and report back to the section regarding their findings.

III-C on Structural Parts: The possible need for specifications covering high-density iron-copper or iron-carbon parts, iron parts for magnetic purposes, brass and bronze parts, and filter materials was discussed at some length. Task groups were set up to determine the need for each and to make recommendations.

III-D on Friction Materials: This section was organized into an active group and possible courses of future activity were outlined.

The main committee also met and heard reports from the various subcommittee and section chairmen, and new members were welcomed into the committee. The formation of a new section on filter materials was suggested and is to be considered by the Advisory Committee at its next meeting.

The problem of the committee in maintaining a balance of interests on its membership was discussed at some length and the need for additional consumer representation emphasized.

Chemical Analysis of Metals

(Pittsburgh, January 18–19)

COMMITTEE E-3 on Chemical Analysis of Metals, which met in Pittsburgh on January 18 and 19, is attempting to bring all of its methods up to date this year and to complete as many new methods as possible in preparation for the next edition of the Book of A.S.T.M. Methods of Chemical Analysis of Metals, to be published early next year.

To avoid confusion between the designations of certain subcommittees of Committee E-3 and those of other technical committees of the Society, as in the case of E-3 Subcommittee B-1 on Copper and Its Alloys and Committee B-1 on Wires for Electrical Conductors, Committee E-3 approved the following changes on designations of the divisions of the committee with corresponding changes in subcommittee designations:

- Division F. Ferrous Metals (former Division A)
- Division N. Non-Ferrous Metals (former Division B)
- Division S. Sampling (former Division C)
- Division G. General Analytical Methods (former Division D)

Proposed Tentative Methods of Chemical Analysis of Copper-Nickel and Copper-Nickel-Zinc Alloys have been completed and were submitted for letter-ballot of the committee. These methods will help materially toward providing a complete coverage of copper-base alloys by A.S.T.M. methods of chemical analysis.

Procedures for use in the analysis of metallic antimony were discussed and samples were distributed for cooperative tests. Subcommittee N-2 on Lead, Tin, Antimony, Bismuth and Their Alloys expects to complete work on these methods and submit them for publication as tentative before the end of the year.

A number of photometric procedures, particularly for aluminum alloys, are being completed. Test methods based on use of the photoelectric spectrophotometer are continuing to predominate among the new procedures being developed by the committee, although the gravimetric and volumetric procedures are also being reviewed and revised where necessary.

Rapid methods for identification of metals, such as spot tests, are in a somewhat different category than the referee type of method Committee E-3 has always prepared. However, such tests are quite widely used and Committee E-3 therefore is making preparations to sponsor a symposium on this subject. Efforts are being made to assemble the material for the symposium in time for it to be held at the 1949 Annual Meeting of the Society in June.

Committee E-4 on Metallography

In Committee E-4 on Metallography the Methods of Preparation of Micrographs of Metals and Alloys (E 2–44 T) is receiving a very thorough revision at the present time, as a part of which the standard for grain size of brass is being divorced from the photography methods and is being set up as a separate standard. Considerable attention is being given to the Recommended Practice for Thermal Analysis of Steel (E 14–33) and it is proposed to issue standards for macro grain size of metals.

Committee E-6 on Methods of Testing Building Constructions

No recommendations were presented on standards, but evidence of considerable study and work was noted in the reports by the subcommittee chairmen.

A proposed Method of Test for Roof and Floor Panels is now ready for subcommittee ballot. The need for a small-scale flame spread test was expressed, as well as a means of correlating results from such a test with those from full-scale tests. The A.S.T.M. Committee E-5 on Fire Tests of Materials and Construction will be informed of the plans for this development which were based on tests already carried on in member laboratories. Committee E-6 will look to A.S.T.M. Committee C-16 on Thermal Insulating Materials for proper methods to use in testing building construction in respect to measuring thermal insulating properties, and approves the broadening of the scope of the C-16 methods to include constructions.

Committee E-9 on Fatigue

The major project of this committee during the past two years has been the preparation of a Fatigue Manual. At Committee Week in Chicago the chapters on Presentation of Data, on Test Procedure and Technique, and on Test Specimens, all of which have been revised since the last meeting, were carefully reviewed and approved. All chapters of the Manual have now been finished and the Manual should be printed and available for distribution before the end of the summer.

Committee C-1 on Cement

During Committee Week, Committee C-1 approved for submission to the Society a new Tentative Method for Determination of Sodium Oxide and Potassium Oxide in Portland Cement with a Flame Photometer, as a quick and accurate method for such determinations.

Some revisions were made in C 151 (Method of Test for Autoclave Expansion of Portland Cement), and arrangements were made to bring safety precautions to the attention of the operators of autoclaves.

Consideration is being given to the preparation of a specification for air-entraining additions to be used for intergrinding with the clinker in the manufacture of air-entraining portland cement under Specification C 175.

There was presented a very complete report giving the results of an extensive investigation to determine the optimum SO_3 content to be used in the manufacture of different types of portland cement.

An extensive report conveyed the results of a lengthy investigation of different strength tests of portland cement. Fifteen laboratories cooperated in the study, correlating the results of mortar strength tests with tests of concretes.

The committee voted to recommend placing a maximum limit of 15 per cent on the air entrained by cements under Specification C 150 when tested in standard mortar according to Method C 185.

A new Tentative Specification for Natural Cement was prepared to replace Specification C 10.

Progress reports were received from all of the subcommittees, indicating continuous activity in their respective fields of work.

Committee C-2 on Magnesium Oxychloride Cements

Nine proposed tentative methods of testing or sampling magnesium oxychloride cements and compositions will now be presented to the Society for publication following a review of comments received from Committee E-1. These represent the first group of test methods formulated by the committee since its organization in 1947. They cover the determination of specific gravity, compressive strength, transverse strength, sieve and chemical analyses, and the sampling of oxychloride compositions and ingredients.

Three additional tentative methods were approved for letter-ballot of the committee. These are: Determination of

Continued on p. 30

What Good Are Standards?

An interesting series of addresses related to the subject "What Good Are Standards?" was presented at the 1948 Annual Meeting of the American Standards Association in New York last October. Following discussions on the legal aspects, and coordinating standards of the armed services, there were two broad problems covered, namely, "Evaluation of Standards" and the specific topic "What Good Are Standards?" Because many members of A.S.T.M. will be interested in these discussions, several of the papers are presented in abstract or as synopses below. The American Standards Association (70 E. Forty-fifth St., New York 17, N. Y.) is publishing the complete papers as a special pamphlet and copies can be procured from the Association at $1.00 each, with reduced prices on orders in quantity. A.S.A. members can procure copies at 75 cents each.

The complete program is listed below and this also represents a table of contents for the A.S.A. publication.

Papers on "What Good Are Standards?"

Evaluation of Standards

ABSTRACTS

Introduction to Panel Discussion

By Willis S. MacLeod, Deputy Director of Standards, Branch Bureau of Federal Supply, U. S. Treasury Department

The question of evaluation of standards has been one of great concern to the standards man from the beginning of standardization activities in industry. In setting the backdrop for our discussion I should like to interpret the phrase "evaluation of standards" to mean the appraisal of the whole gamut of organizing and operating standards work and why it becomes a fundamental element of industrial operation.

The part standardization plays in purchasing activities and the difficult problem of establishing in monetary and intangible savings and benefits which result from standardization have been continually before each of us in justifying to management our very existence. Some of us feel that the standards organization should be subordinate and responsible to engineering. Others feel that it should head up under purchasing and still a third group feels that its benefits accrue largely to production operations.

There have been innumerable approaches to bases for establishing the money savings which result from standards activities and from standardization. There have also been groups who have steadfastly adhered to the principle that monetary savings could not be estimated.

That there are divergent views on each of these subjects so fundamental to standardization work and the part it plays in production, purchasing, distribution, and warehousing needs no elaboration. The viewpoints which follow will generate some very lively questions.

Is Standardization an Engineering, Purchasing, or Production Function?

By W. P. Kliment, Engineer of Standards, Crane Company

Analyzing the subject question, it can be seen that there are many approaches, and the problem can resolve itself in many ramifications and become highly controversial. Further, you will agree that this is a broad subject and numerous conclusions can be arrived at, depending upon the products manufactured, the structure of the organization, effect of an interest shown in standardization by the particular institution.

Another factor is important, namely, the "Sales Function" and should be considered here since standardization does reflect and ultimately result in savings both to the manufacturer and the consumer.

So that the greatest benefit can be derived from standardization, the first step must be to establish certain principal objectives as follows:

1. To promote the development and maintenance of sound engineering and manufacturing standards so that the maximum interchangeability, simplification, economy of manufacture, improvement of quality with possible savings to the consumer, and consistency of appearance will be secured.
2. To avoid duplication of effort.
3. To cooperate in the development of appropriate industry standards, codes, and ordinances which pertain to the manufacture, sales, and installation of company products.
4. To recommend representatives to national and international associations and national, state, and local government committees that develop codes and standards.

The next step in the application of standardization is the necessity to analyze and investigate the number of standards, codes, and specifications which have a direct bearing on the product.

The third step should be an analysis

of the different standards in order to determine what departments, divisions, or sections have an interest, make use of them, or are affected by them.

In order to keep abreast of these standards, and in order to participate in their formulation, it is necessary to be affiliated with many organizations and contribute toward the work, both from a monetary and an engineering standpoint. Further, it must be realized that due to the broad scope and the many subjects that standardization encompasses, it is practically impossible for one man to cover the entire field. Consequently, it is necessary that a certain amount of this work be delegated to individuals who are specialists in their particular field and assign them to subjects with which they are well acquainted.

New codes or standards play an important role in engineering, production, purchasing, and sale of products when they are issued or revised. They may affect drawings, designs, and other factors in engineering. They may necessitate new patterns, dies, gages, and other production equipment or changes in existing ones. Catalogues and other bulletins may have to be revised or new ones issued. All of this information must be filtered through a closely knitted organization so the greatest benefits can be derived therefrom.

With this picture before you, I believe, the answer to the question "Is Standardization an Engineering, Purchasing, or Production Function?" is obvious. There is no question in my mind that all of these standards and the many affiliations present a great number of company policy questions and problems inasmuch as the changes due to standardization may affect several divisions of a company, and, therefore, do not fall into any particular division, but are, rather, cooperative functions of all. It is, therefore, my opinion that the individual under whose direction standardization should come should be an officer of a company. However, the administrative end should be under the directorship of the Engineering Department since an Engineer of Standards must consult, and be guided by, the engineers in making practically all of the decisions and proposals. The Engineer of Standards should be a person whose judgment is practical and sound, and who knows the product.

Interrelation of Standardization and Purchasing Activities

By Arthur J. Beck, Editor of Standards Catalog, Detroit Edison Co.

MATERIALS and equipment standardization is an important management tool for effecting savings and other economies through the process of simplification. Another aspect of standardization which is significant to both manufacturers and industrial consumers is the aid standardization gives to purchasing and other supply operations, such as stock control. This aid can be applied not only to the supply of production materials but also operating and maintenance items.

When a company is small, structures are rather simple and can be built to answer the purpose satisfactorily without a lot of preliminary design. If construction people run into trouble, they change materials on the spot to get what appears to be a better answer. Maintenance people do likewise. This is all right as long as structures are few and construction and maintenance organization relatively small.

Difficulties arise, however, as a company grows and expands its forces. A greater variety of materials are used to get a job done. Considerable attention is given to major plant equipment but not to the so-called minor items. Typical of these minor items are bolts, tools, etc. They are as important as the major items, for without them the major items cannot be installed or will not function.

Part of the difficulty results from a lack of understanding by many of the people involved with supply. These people need at least a fair mental picture of each item of supply with which they are concerned. Each of them must use the same terminology when referring to an item. Otherwise, endless confusion and added costs rapidly enter the picture. When a company is small, employees have enough information. They are in intimate contact with each other and inherently know quite a bit about what is going on. As the company grows, it becomes more difficult for the people concerned with supply to obtain adequate information on the materials and equipment used in the business.

In buying materials and in controlling stocks, there is considerable confusion. Records and requisitions are often badly written so that, at times, buyers do not know what they are to buy, or what is in stock. Often the wrong materials are received, involving additional freight costs as well as longer wait for delivery of the right items. Buyers feel that an unusually large number of trade-named items are being specified, thus depriving a company of the advantages to be gained by introducing competition among suppliers.

These conditions can be corrected by establishing a standards program.

The objectives of the program:

1. Simplify the variety of materials and equipment required in the operation and maintenance of existing properties and in the construction of new facilities. This means—
   (a) The selection of the best item for each job, and
   (b) The elimination of unsuitable and obsolete items.
2. Develop adequate descriptions and specifications for standard items.
3. Use these descriptions in supply porcedures, *i.e.*, those procedures involving the planning, design, procurement, storage, and use of materials and equipment.

Standards having been decided upon, it is necessary that this information be broadcast to the company, and be made available to the designers, engineers, stores, and using departments. Descriptions of the items, of course, are a vital part of this procedure. Descriptions are developed and are immediately used in supply procedures as follows:

1. They are distributed to all people who requisition material from stock or directly from the purchasing department.
2. Abbreviations of the descriptions appear on design drawings.
3. The descriptions form the basis for stock records and appear on purchase orders.

A word about descriptions may not be amiss. Our aim is to make the description of each item clear and concise, with adequate but not superfluous information. The description should be such that it gives both the clerk and the engineer a mental picture of the item. In addition, it is important that one and only one item meets the description.

In conclusion a standards program has been and still is very effective in providing vital information and service which are a "must" for a successful and efficient supply program.

Methods of Evaluating Savings from Standards Work

By William Floyd, Assistant to Vice-President in Charge of Merchandising, Sears Roebuck and Co.

To THE best of my knowledge no over-all evaluation of a single standard or of a standardization program has ever been attempted. While nearly all business executives are keenly aware of the long-range value of standards, few, if any, have put standardization on a cost-accounting basis. Lack of a satisfactory method of evaluation unquestionably places standardization work on the defensive in most companies. We all know the story. Someone in the organization sees the standardization vision. He knows that his work will pay dividends. He wants to go ahead with it. He wants to do a job. But half of his time has to be spent selling, justifying, and fighting for appropriations.

Contrast this to the position of a salesman. The salesman comes into the front office and says "here is a hundred thousand dollars in signed orders." The profit on them is ten thousand, so why quibble about the few hundred dollars' selling expense involved in getting this business? Most companies don't quibble about selling expense, as long as the business is coming in at a reasonable ratio.

The same thing is true of the production department. Production costs on the new product will be fifty thousand dollars. The product will sell for a hundred thousand. So there is no question about incurring the fifty thousand dollar production expense.

When it comes to standardization, however, the story is different. The evaluation itself may cost more than the exact knowledge is worth. In that case, a person has to use his judgment. But I believe techniques do exist for evaluating standards.

Generally speaking, product standardization means just one thing: fewer products—fewer products purchased in the way of materials, parts, or supplies, or fewer products manufactured.

The economies of fewer products can easily be reflected in standard cost comparisons. Take the supply room first. The usual claims of standardization are lower inventories, and less purchasing and supply room expense.

It is well within established techniques of standard cost accounting to evaluate these factors. From utilization or demand schedules, it is possible to calculate maximum, minimum, and average inventories, together with the number of orders that must be placed in a year's time. From the number of units and their prices, standard inventories can be calculated. From units, orders, receipts, and stock disbursed, together with ordering, receiving, stocking, and disbursing times, standard operating costs can be calculated. Thus, if a standardization program reduces stockkeeping units by given percents in different categories, a dollar and cent difference in standard cost, between stocking the larger number of items and the smaller number of items, can be calculated.

These remarks are admittedly an oversimplification. There are advantages to standardization other than fewer products. And the calculation of standard costs is more complicated than my brief outline may imply, as all of you who are familiar with such work well know. But there seems to be no reason, in theory, why the standard cost method is any less applicable to the evaluation of standardization work than it is to the evaluation of any other claimed economy in purchasing or production.

Practical Answers to a Practical Question—What Good Are Standards?

ABSTRACTS

Keynote Address by the Moderator

By Earl O. Shreve, Pres., U. S. Chamber of Commerce

THIS is the last quarter of a record-breaking year for American free enterprise in peacetime production and all-time employment. Our production index is up more than a third as high as any previous peacetime peak and 60,000,000 people are in our labor force.

Every record has its reasons—every effect its causes. Improved engineering and production techniques effected a step-up in capacity. The channeling of supplies for the war created an imbalance between civilian supply and demand which needed adjustment. The threat of a new conflict and the belief that great production will offset it has been important. However, another factor is STANDARDIZATION.

Industry has long recognized the utilization of standards as a means to accelerate mass production and has adopted them voluntarily. Standardization came into its own in the recent World War since it put a highly coordinated industrial army into the field in a period of months with a resulting production previously considered impossible. Today it continues to influence our production index, affecting, in turn, the welfare and security of every American.

Outside the professional field, few people realize the value of standards, although standards on materials have been lived by as long as those in the realm of spiritual codes. The application of additional standards in industry is but the adapting of a common technique to much broader fields for unraveling complexities beyond the comprehension of laymen.

The one danger lies in the possibility of government assuming proprietary interests in standardization. Today the government is a technical assistant of real and practical aid, but standards, *per se*, must be *voluntarily* determined and adopted, that is, be free to change and develop as industry moves ahead and in no sense be restrictive mandatory controls. Such standards represent the "know how" that has made American industry the productive giant upon which the world has come to depend.

Leadership comes from industry in general, but much responsibility rests with the executives of trade associations, technical societies, and consumer groups. Yet, only the surface is scratched, and an enormous amount of work needs to be done on a voluntary basis. *The extension of such constructive work is the most fruitful means of avoiding restrictive legislation and regulation.*

The legal machinery of our states must be perfected to take full advantage of standards in broader fields than at present; unfortunately, here is a long road to travel.

Our productive strength here in America may be the only answer to the

"holding" strength of our friends abroad. It is a constant source of hope and amazement for them. We have so much here at home, yet so much left over. There are hundreds of answers—answers which are inherent only in a free and vigorous economy—but the techniques of *simplification and coordination* certainly stands near the head of the causes behind the effects.

The detail of answers to the question: "What Good Are Standards?" is left to our panel of distinguished experts.

What Good Are Standards in Specifying and Purchasing Manufacturing Materials?

By V. de P. Goubeau, Director of Materials, RCA Victor Division, Radio Corporation of America

It is not a matter of inquiring what good are standards in connection with the purchasing function, but, rather, the question of how to operate without them. It is not often realized that pricing is a fluctuating yardstick depending largely on quantity *and* quality. There must be some standard of measurement if any intelligent decision is made between sources and products. Accordingly, we begin with the conviction that *standards in the procurement of manufacturing materials are vital to an efficient operation.*

Purchasing activity has gone on for hundreds of years, but only recently, with the development of large-scale mass production and an increasingly complex industrial life, has purchasing become recognized as an important cog in commercial life. This led to the use of scientific methods and specialized skills to meet the responsibility. Today, through the use of standards the purchasing agent conveys to his supplier of raw materials, semiprocessed goods or finished components, an exact understanding of what is required, the terms of exchange and conditions upon which the material will be accepted or rejected. This simplifies the problem of procurement. The use of standards makes possible a satisfactory competitive situation conducive to close pricing, rigid quality control, product dependability, and good customer service. Then the buyer can place business with confidence in his merchandise and with minimum inspection and testing.

National and international standardization sponsored by trade and technical associations through the facilities of A.S.A. goes far in providing the foundation on which the purchasing department can operate. With standardization exploited to the fullest, the area of virgin territory purchasing must concentrate, is reduced to a minimum. Volume is created in many staple items and advance stock buying can be practiced. A company which operates without standardization is one which will never be competitive and therefore leads itself to early liquidation.

The advantages to a company which makes good use of standards are numerous, for example:

Inventories: A minimum inventory expense results. Inspection is simplified and disagreements concerning quality and interpretation of the article ordered are held to a minimum. The handling of materials is a minor problem when an article is standard instead of in numerous variations.

Cost: Special setups for the use in production of small quantities of varying items result in major costs. This we eliminate through close operation with standard commercial specifications in procuring necessary materials.

Availability: When purchasing common standard items the supporting of production lines is simple. The scheduling of deliveries and drawing from inventory stock is reduced to a clerical function. By using standard articles, materials are also available from numerous concerns instead of just an individual one.

Cost of Engineering Function: The preparation and use of voluminous drawings, necessitating extensive work by engineering personnel, increases the cost of a product since there are numerous special items to be prepared for this purpose. Standardization keeps this to a minimum.

The problem of holding in check the variations in standards is a serious one. Selected are a few illustrative cases.

1. The early radio industry faced a problem in connection with the production of *radio receivers.* The standardization of tubes tremendously simplified the problem of radio circuits, and the concentration on a limited number of types with the consequent volume of production made it possible to reduce costs from three or more dollars to a few cents.

2. *Insulated electrical conductors* are essential in every piece of electrical equipment. Determining the correct wire for a specific purpose involves considering many conditions. Standards have been written covering various wires, and numerous specifications previously in use were eliminated. Dollar savings resulting from this project are extensive in the two departments most active in the use of wire. It can well be realized what the standardizing of wire for use in radio or television might mean.

3. *Intermediate frequency transformers* are used in practically every radio device, and thousands of designs have been adopted. After the war, the radio industry was faced with a serious shortage of materials and components. Aluminum shield cans for the transformers were inadequate in supply. There were 41 size variations on one type, and, in addition, variations in notchings, holes, and spacing accounted for as many as 125 different cans in use. The 41 variations were reduced to seven, and the variation in notchings, etc., were eliminated through a few standards. Thus an adequate supply was available, business became profitable to the producer, and, therefore, adequate competition was renewed. Similar progress was made in connection with the transformers themselves—the types were reduced from 113 to 34.

The R.C.A. Victor Division is constantly checking its work in the use of standardization, but at the same time is not restricting the vision or initiative of people in introducing new and greater things in electronics. Research and development is constantly encouraged, but inefficiency in production lines is not allowed through the use of nonstandard items.

What Good Are Standards in Manufacturing?

By Harold L. Hoefman, Vice-President, Link-Belt Co.

Standards in manufacturing have been of immeasurable value in promoting economy, efficiency, customer service, a common basis of understanding, and have brought order out of disorder and chaos in the industrial field.

The individual position, the peacetime economy, and the military defenses of the nation all have been greatly strengthened. Standards in practice make for more effort in the march of progress.

A detailed value study of standards may be developed on the following bases: less machine time setup, standard operations, quality control, safety, and cost reduction.

A. Less Machine Time Setup

The contributions:

1. More interchangeability of piece parts makes for larger productive runs and fewer machine setups.
2. Time study engineers by analysis are able to standardize and train men on different setups.
3. The setup man is also greatly influenced by standardization practiced in machine designs and light tooling. Interchanging of tools between machines of the same size and type should be practiced.
4. A streamlining and a progressive order of variances (*e.g.*, material specifications) in different products has helped to achieve a similar result in machines and light tooling.

B. Standard Operations

The contributions:

1. Items listed under *A*.
2. Other contributions.
   - (*a*) A machine operator can procure immediately small tools necessary to perform his operation.
   - (*b*) No time is lost in making and grinding new tools; replacements are readily available.
   - (*c*) An orderly code of machine finishes with the use of gages gives specific information eliminating misunderstanding and errors.
   - (*d*) A standard method of detailing a piece part is devised for easy interpretation by shop men.
   - (*e*) Standard allowances are made in fractions when work is not held to a precise dimension.
   - (*f*) The convenience of the use of piece parts in assembly is also true with repair parts.

C. Quality Control

The contributions:

1. Items under *A* help to achieve consistent quality and eliminate errors that impede assembly and render repair service necessary.
2. Item *B* 2 (*c*) applies to quality control men, shop men, supervision, and the Time Study Dept.
3. Item *B* 2 (*d*) makes for economy and quality.
4. Quality control has been made possible by use of piece part drawings in shops instead of copying former parts using rough sketches, or by carrying mental notes of machining dimensions.
5. An orderly progression of models makes possible measuring instruments; the latter results in interchangeability, economy, and proper inspection.
6. Quality control and all the things making it possible promote mass production.
7. Both chemical and physical analysis may be used in standardizing the elements making quality control possible.

D. Safety

The contributions:

Standards for the control of hazardous conditions in the following:

- (*a*) Building codes.
- (*b*) Boiler house inspection.
- (*c*) Traffic signals and driving.
- (*d*) Amount of light.
- (*e*) Guards on machinery.
- (*f*) Crane operator signals in handling loads.
- (*g*) Method and the amount of employee weight lifting.
- (*h*) Ladder design
- (*i*) Material storage.
- (*j*) Proper workmanship
- (*k*) Use of chains for lifts.
- (*l*) Rules of conduct.
- (*m*) Good housekeeping.
- (*n*) Crane lift capacities under varying conditions.

E. Cost Reduction

The contributions:

1. Setting up workable standards that are orderly, simplified, and economical in application makes for greater over-all economy, plant-wide, company-wide, and nationally.
2. In summary:
   - (*a*) Setting up standards for direct labor operations.
   - (*b*) Setting up standards for overheads and parts thereof.
   - (*c*) Standard times established on the elements that make up an operation cycle make it possible to establish over-all times and reasonably accurate estimates.
   - (*d*) Setting up standards of strength on various materials make it possible to design economically and not by trial and error.
   - (*e*) Interchangeability of parts makes for greater production runs, more division of labor, greater turnover of product, less inventories, less capital required, and a lower cost per unit.
   - (*f*) Standardizing all the elements have a bearing on piece parts and the finished unit results in the benefits of (*e*).
   - (*g*) Standardization of paper forms used in industry and its subdivisions leads to cost reduction.
   - (*h*) Streamlining in accounting procedures and other paper operations result in cost reduction.

What Good Are Standards in Marketing?

By R. C. Sogge, Executive Department, General Electric Co.

THE successful marketing of a product is an important and essential part of any business, because only through efficient marketing can the costs be recovered, and we hope something in addition for profit, and to carry on in the future. While the marketing program varies depending upon the character of the product and the character of the market, there is a similarity of pattern which covers marketing for most businesses.

In every marketing operation, there are certain objectives which must be accomplished:

1. A sufficient volume of business to permit operation on a profitable basis.

2. A certain degree of stability in sales to permit an even distribution of the work for utilizing facilities and man power to best advantage.

3. A proper distribution of the product to customers for the security and sound growth of the business.

4. The marketing operations must be on an economical basis to contribute a share in the effort of the over-all business to be competitive in price, in quality, and in service to the customer.

5. The stocks of products in the various warehouses must be large enough to give good service without creating an inventory problem.

6. The plans and operations in marketing must be coordinated to other phases of the business.

One factor contributing to the production of a uniform product at the lowest manufacturing cost is standardization. Most of the printed information on the benefit of standardization relates to purchasing, designing, or manufacturing, but careful consideration indicates that appropriate standardization will help keep the marketing activity in the best of health.

Any standards are good only to the degree that they assist in performing the desired job more efficiently, more economically, and to the greater satisfaction of all concerned.

How marketing objectives are met by using standards:

1. Standard ratings can be identified with catalogue numbers which can be listed in price books and catalogues. The sale of standard items minimizes the expense of preparing requisitions. Manufacturing orders for standard products can be placed on the factory to accumulate stocks for future business.

2. The selling job will be easier if the product is standard, because sales arguments can be worked up for the line and experience from previous sales will be useful in obtaining new orders. Satisfied customers will be interested in duplicating previous purchases.

3. An advertising program will be economical and can be justified if the cost can be spread over a volume of standard products.

4. If installation is involved, it will be easier to train crews to install standard products.

5. With a standard product, there will be less need for servicing and it will be easier to train the service men. Standard parts will fit standard products, and, because they are interchangeable, a small inventory will provide an adequate back-up to render good service to a large number of customers.

6. Customers are soon educated to specify products which have given satisfactory service. The customer can specify that all bidders meet the standard, and competitors will be required to provide something that is comparable.

7. An industry can have safety standards which make the product more acceptable to purchasers.

8. If the product is to enjoy the widest market, then industry standardization through the trade associations or the technical societies would be in order. Industry standards will enable each manufacturer to participate in a larger market

which, in turn, will contribute to the stability of his business.

In summary, the net result will be that customers will get better products which will be easier to install, at costs which will enable the industry to have a sound expansion. All of these things contribute to making the marketing job more efficient and more economical. The sale of standard items makes possible better business statistics because the figures will be more nearly comparable.

Industry standards also provide the basis on which the industry can cooperate in the promotion of major projects, which helps all branches of the industry. No one company can finance such projects by itself, but by all industry pulling together the job can be accomplished with a reasonable cost to each company. American Standards which have the approval of all interested groups, including branches of the federal and state governments, will be less subject to criticism. Costly duplication of effort in the making of individual company or industry standards will be avoided.

We can conclude that standards are good for marketing and that those responsible for this very important phase of our business should pay more attention to proper standardization.

What Good Are Standards to Wholesalers and Retailers?

By Gerald C. MacDonald, formerly Manager, Merchandise Testing and Inspection Dept., Montgomery Ward and Co.

STANDARDS are utilized in every phase of wholesale or retail distribution. This statement is not as startling as it may sound for the simple reason that standards are essential in the conduct of human affairs. Without standards of conduct, measurement, and many other things, people could not coexist in civilized communities. Neither can a business organization operate efficiently and intelligently without the utilization of standards.

Simply stated, a "standard' means any fact, thing, or circumstance which forms a basis for comparison, evaluation, or specification. If everyone in modern industry understood the word "standard" as meaning no more than *that* definition, misunderstandings would disappear.

Where would we be in the distributing industries without standards? How could we describe our products in promotional efforts without having terms that are clearly defined?

For example, garments must be cleaned, and as a result consumers want to know how their contemplated purchase is to be handled. The dyestuff industry has produced thousands of dyes having various degrees of fastness to washing. In order for a distributor to be able intelligently to inform his customers concerning this very essential factor, there must be standard methods of test for classifying the colorfastness to washing of dyestuffs.

Technical men have cooperated in such organizations as the American Society for Testing Materials and the American Association of Textile Chemists and Colorists in developing standard methods for classifying the colorfastness of materials to washing.

Think for a moment of an entirely different type of commodity—the water heater, for example. A large merchandising company distributed water heaters through the same promotional medium but from two different divisions. It will be no surprise to those who are experienced in standardization to hear that two different methods of rating these heaters were used in the *same* promotional medium. Each gave the capacity for heating water in so many gal. per hr. but in one case the capacity was calculated on a 25 deg. rise in temperature and in the other on a 60 deg. rise in temperature. The value of standards in this case was quickly realized; first a company standard was set, then an industry standard determined, and finally a commercial standard for manufacturers, distributors, and consumers promulgated.

Standards of the type discussed are one of the best competitive tools which distributors can utilize in obtaining a premium for better merchandise. They enable the seller to present the superiority of his product in clear, understandable terms; in fact, they give him the terms to show where his product is superior.

There are many excellent examples of where lack of adequate standards causes confusion. It is almost impossible to convey by words the appearance of each of the colors used in merchandise. One large distributor spent many thousands of dollars in developing a color catalogue to utilize in his buying and promotional operations. The thing was a "flop" for the very simple reason that it was only a company standard with little acceptance outside of the company, and the terms were but vaguely understood by the company's customers.

Technically, there is no such thing as "perfect" merchandise any more than there is a perfectly round circle. Things are commercially "perfect" only in conforming to certain tolerances or standards. When retailers are able to cooperate with producers in setting standards of acceptability which meet with customer approval, we have gone a long way toward minimizing misunderstanding and promoting good will among the consuming public. What defects, how many, and in what location on chromeplating are acceptable? To what degree are irregularities in enamelware acceptable? Is a blistered decal in dinnerware acceptable? If so—when, where, and to what degree? All these and thousands of similar questions require answers through standards.

In our internal structures, just as with any other industry, it is essential that we have output standards and accuracy standards. Let us consider a mail order house, which may be likened to an assembly plant wherein bulk merchandise is received in quantity, examined, prepared in individual units, warehoused, and stocked for shipment to individual customers. The customer's order is received through the mail and order clerical operations begin. Subsequently we will have pricing, order filling, checking, sorting, packing, scaling, billing, and shipping. To perform all of these operations efficiently, we must have output standards just as would be the case in a manufacturing or assembly plant. These output standards are developed through the use of accepted time study methods and standards development procedures.

Accuracy standards must be set which will reflect an allowable error percentage for an average competent workman while performing a given operation. Accuracy standards allow us to spot carelessness as well as outstanding workmanship.

Accuracy and output standards considered together with the versatility and dependability of employees go a long way toward insuring that the individual employee will receive a fair appraisal and equitable wage rate.

The value of standards in packaging certain types of merchandise for distribution cannot be overemphasized, especially when it is to reach the ultimate consumer. Few people are fully aware of the abnormal conditions each package will encounter in its travels. The product may be ideally packaged for this first leg of the journey to the ultimate consumer, but will it withstand the additional handlings and the multitude of shocks inevitably found? Even though loss and damage claims may be promptly paid by the carrier, these conditions often result in the loss of the profit involved in the sale of the merchandise and in customer dissatisfaction.

The solution to this problem is, of

course, standards compiled after tests have been made to determine the adequacy and economy of both materials and design.

Every large distributing organization in existence today is spending substantial sums of money each year in order to develop company standards and to coöperate in the development of industry and nation-wide standards.

There is no question but what well-directed programs of standardization within and among distributing organizations reduce costs, increase public good will, and promote clean competition in private enterprise.

What Good Are Standards to the Ultimate Consumer?

By Carol Willis Moffett, Director, American Standards Association

Our common sense tells us that standards are as good for us in managing our own resources as they are for managing the resources of industry and commerce. The tremendous amount of consumer education which now permeates our schools and colleges stresses the value of standards. The 30,000 trained home economists in the schools, colleges, and the extension service which serves rural families in our 3200 counties are talking to classes and adult groups today about the handicaps under which their limited incomes are spent, how they can make the best of a difficult situation, and what they need to do a better job for themselves in the future. Teachers of science, mathematics, agriculture, and other subjects are doing the same, because relating these subjects to everyday purchasing problems gives a more realistic approach.

We have taken the factory out of the home and made the homemaker the chief purchasing agent for the family, but we have not given her enough tools to help her do her new job well, nor to enjoy doing it. Then we wonder why so many women feel frustrated, and are deeply resentful of the conditions under which they have to exchange the family's limited resources for necessary goods and services. Our current inflation serves only to deepen these feelings.

The big question is not what good standards are to ultimate consumers. This was answered long ago in the minds of thoughtful men and women. They believe in the necessity for more practical aids to consumer purchasing in this technological era. A great many of them have spent lavishly of their time, energy, intelligence, and personal funds, not only to make the value of standards more widely known and appreciated, but to bring more desperately needed standards for consumer goods into being and into practical use.

The bottlenecks in this situation are obvious enough, but how do we break them? The A.S.T.M. has published a 560 page book of standard textile test methods and specifications, but you and I cannot go into a single store in New York and find more than a small fraction of those standards referred to on labels, or see them mentioned in newspaper advertising. The salespeople usually are as handicapped as we consumers for want of relevant facts.

But we can go into any public library which subscribes to certain consumer publications and find that no magazine on the shelves is more worn with use than their reports. They are popular because they are trying to answer the questions consumers are asking, such as how well a product does the job for which it was intended, how it compares with similar products, how durable it is likely to be, and which is the best buy for a family's needs at the price it can afford to pay.

If all the good intentions which are going into efforts to develop standards useful to consumers are going to be worth much to us, we must be more imaginative than we have been in the past in making them useful to buyers at retail. As consumers, we never can hope to become technically proficient judges of the vast number of goods and services we need in a lifetime, or make laboratory tests of the things we contemplate buying. We cannot use the methods which professional purchasing agents employ. But certification procedures could be improved so they would command more confidence. Abuse of certifications has made us wary, and we need to know what a product is certified for, as well as how honest and competent the procedures for certification have been.

There is another bottleneck which will be even more difficult to break. This is the attitudes we have acquired as earners of incomes. Men and women employed by business concerns often approach this question of developing and using standards for consumer goods and services as though it were dynamite. They seem to forget that they are consumers, too. The tendency is to proclaim the value of standards for the other fellow's product or service, but to put obstacles in the path of developing completely useful standards and adequately informative labels for the product connected with one's own way of earning a living. Some trade association representatives want a standard so low that the most inefficient producer in their business can get by under it. Others stall in the hope of wearing out the advocates of a good standard. Some retailers fear the price competition of more efficient distributors if all the facts about goods are told. The net result is to rob their own incomes, as well as ours, of buying power.

Wouldn't we get further in solving this problem of getting more standards and putting them to work if we faced squarely the fact that our economic system has proved flexible enough in the past to adjust itself to new ways of doing business? That giving ourselves all the facts we want and need to use our personal incomes widely and well is just as good sense and good business as industrial and commercial use of standards?

We all know that without industrial standards we would not have electricity and telephones in our homes today. We know these standards have brought such products as automobiles, radios, and labor-saving appliances within the reach of many incomes in this nation. We find indispensable both the voluntary and mandatory standards which safeguard our lives and health, and attempt to control fraudulent practices. But we know also that a beginning has barely been made in that big area which would help us to become more skillful buyers. The price tag has little meaning for us unless we can learn *what* is being offered at a given price as clearly as our standards for weights and measures tell us *how much* we are getting. No searching studies have been made of the money value of such standards to each of us, but several guesstimates have placed it at 25 percent additional buying power for our incomes. And who couldn't use a 25 percent increase in his level of living?

A.C.I. Standards—1948

The 1948 edition of A.C.I. Standards published by the American Concrete Institute represents a collection of all existing standards adopted and issued to date with the exception of the "Manual of Standard Practice for Detailing Reinforced Concrete Structures."

These standards cover the field of concrete design and construction—a field which A.S.T.M. does not enter but which is of direct interest from the standpoint of standards on materials used in concrete construction.

The most comprehensive of the several standards cover building code requirements for reinforced concrete, recommended practice for the design of concrete mixes, and specifications for concrete pavements and bases.

Copies of this publication may be obtained from the American Concrete Institute, New Center Building, Detroit 2, Mich., at $2 each for non-members and $1.50 each for A. C. I. members.

The Standardization and Simplification of Steel Products

By L. H. Winkler[1] and J. G. Morrow[2]

(Synopsis)

EDITOR'S NOTE: This paper was presented at several regional meetings of the American Iron and Steel Institute. The authors, both active in A.S.T.M. for many years, are members of the A.S.T.M. Board of Directors, and Mr. Morrow is the senior A.S.T.M. Vice-President. While the scope of the discussion is specifically steel products, many of the comments and much of the information, is applicable to other materials fields. The complete paper, together with numerous others, which were presented at the A.I.S.I. meetings have been compiled in a separate volume, a copy of which can be procured from the Institute offices, 350 Fifth Avenue, New York.

No attempt is made in this synopsis to indicate where portions of the paper have been omitted. The aim has been to present a quite condensed but connected synopsis.

WE, IN Canada and the United States have been enjoying a standard of living unsurpassed anywhere on earth. As the result of courageous and independent action of the early settlers in developing a simple code of government, encouragement has always been given to the spirit of free private enterprise in all forms of useful human endeavor. The results of fundamental research have been applied to the mass production of the modern conveniences which we regard as essential, but which appear as miracles to millions of peoples in other lands.

Advances in science, technology, and industry have not all been due to efforts of individuals working alone. Various industrial associations, engineering societies, and professional associations have helped to build for a better life in this new land. The influence of these associations and societies has become international in its extent. For example, the American Society for Testing Materials has become recognized as the foremost specification-writing body in the world.

In engineering and industry, as well as in every other human activity, standardization and simplification are mandatory. Dr. Lyman J. Briggs, formerly Director of the National Bureau of Standards, wrote as follows on the philosophy of standardization:

"We need only glance at the rich background of standards in nature to gain perspective and obtain a better appreciation of present trends in standardization and their significance. In the same species of plants, fishes, birds, or animals, individuals resemble each other in the minutest detail of structure and function. So thorough has nature been that every species may be recognized by the standardized organs, functions, characteristics, or habits peculiar to each. At the same time individuals exhibit definite distinguishing characteristics and develop in diverse directions to stimulate the natural processes of selection, survival, and evolution.

"The more the mysteries of nature are dispelled by knowledge, the more is standardization revealed, as in the geometric arrangement of crystal formation, predicated discoveries of new chemical elements, or the coming of a comet. We depend upon the meticulous regularity of the sun's appearance, the recurring phases of the moon, and the perfectly timed rotation of the planets. We accept as indisputable facts the definitely established boiling and freezing points, the peculiar behavior of certain materials and the changeless normal properties of elasticity, strength, hardness, ductility, viscosity, refractivity, electrical conductivity, permeability, and other properties of elemental things of nature which man is constantly appropriating for his use.

"The variations of color available to the painter are composed of parts of a narrow band of spectral wave lengths and all of the artistry in music is conveyed through another small group of frequencies. And yet we hear no complaints that nature has carried standardization to extremes, that life is dull, drab, or dreary as a result of standardized chemical elements, standardized crystalline growth, or wave lengths, as in sound, radio, light, and X-rays.

"In every direction we find standardization, whether we look to the orbits of electrons about the atom, the constellations of the stars, the microcosm or the macrocosm, industry or sport, commerce or the arts."

The benefits to be derived by everyone from a program of simplication are as follows:

TO THE PRODUCER AND MANUFACTURER

1. Less capital tied up in slow-moving stocks.
2. More economical manufacture due to simplified inspection requirements, longer runs with fewer changes, less idle equipment, less stock to handle, etc.
3. More permanent employment as contrasted with seasonal employment.
4. Larger units of production and less special machinery.
5. More prompt delivery.
6. Less chance of error in shipment.
7. Less obsolete material and machinery.

TO THE JOBBER, WHOLESALER, AND RETAILER

1. Increased turn-over.
2. Elimination of slow-moving stock.
3. Staple line, easy to buy, quick to sell.
4. Greater concentration of sales efforts on fewer items.
5. Decreased capital invested in stocks and repair parts on hand.
6. Less storage space required.
7. Decreased overhead and handling charges.

TO THE CONSUMER

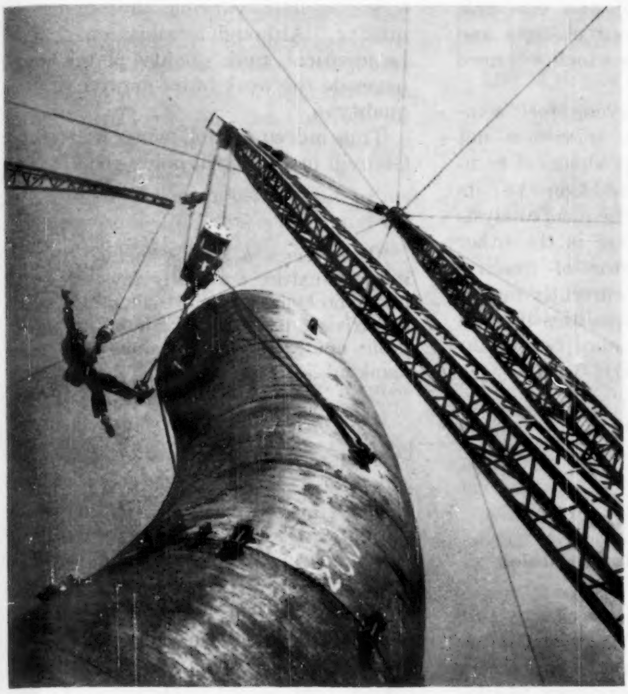
1. Better values than otherwise possible.
2. Better service in delivery and repairs.
3. Better quality of product.

If we in North America did not have the standard track gage and the essential standardization of rolling stock, railroad transportation, as we know it, would be impossible. Were it not for the standardization of structural sections the cost of erecting steel buildings and bridges would be beyond reach. Without standards in the construction of automobile parts and equipment, transportation on our highways would fail because of the impossibility of prompt and proper maintenance. Everyone knows that standardization in weights and measures is indispensable.

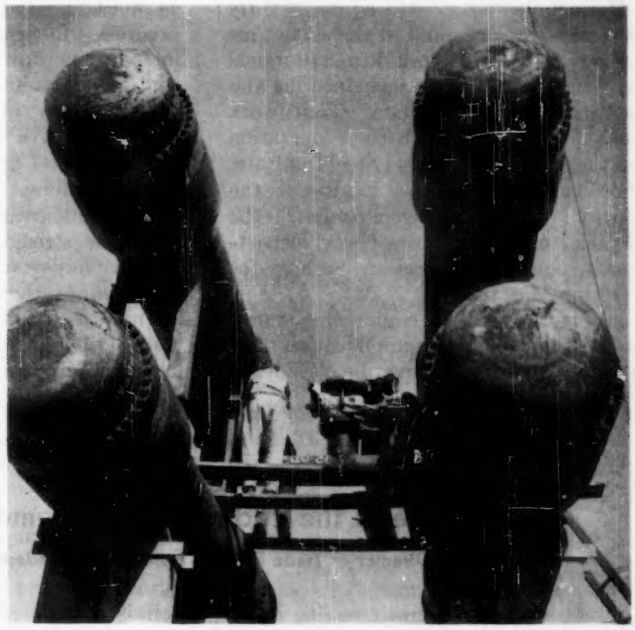
Since progress can best be made when qualified men have the opportunity to discuss their common problems, it was natural that engineers concerned with the manufacturing and the use of engineering materials should form an association devoted to the development of methods of testing and to the formulation of standard specifications. Thus the American Society for Testing Materials, which had its beginning in 1898 as a committee of the International Association for Testing Materials, was incorporated in 1902 under the laws of Pennsylvania. The committees of this Society are balanced committees composed of engineers representing con-

[1] Metallurgical Engineer, Bethlehem Steel Co., and Chairman, General Technical Committee, A.I.S.I.

[2] Metallurgical Engineer, The Steel Company of Canada Ltd., and Member, General Technical Committee, AISI.



Construction of Fluid Catalytic Cracking Unit. Iron Worker Rigging Section of Spent Catalyst Standpipe Before it is Set into Place in Main Structure. This Pipe is 105 Inches in Diameter and Weighs about Fifty Tons.



Photographs courtesy Standard Oil Co. (New Jersey)

Construction of Fluid Catalytic Cracking Plant. Pipe Fitters Setting Control Valve in Piping on Heat Exchangers

A.S.T.M. Specifications Used for Steel for Petroleum

THE accompanying photographs, and the brief notes, not only indicate a rather spectacular use of A.S.T.M. specifications to cover important uses of steel, but they also point up to some extent the interdependence of materials. The particular structure in course of fabrication and erection is the world's largest fluid catalyst cracking plant at Linden, N. J. It was described in the November issue of *The Lamp*, of Standard Oil Co. (New Jersey).

When completed this monster will ingest, every twenty-four hours, 41,000 barrels of gas oil, a light oil obtained by distilling crude petroleum. The cat cracker's job is to break down the gas oil into molecules and rearrange them into other products. It yields principally gasoline, some heating oil and small quantities of other products.

Advice from the Esso Engineering Department indicates that among the numerous materials required in the plant, which were covered by A.S.T.M. specifications are those noted.

This list is not intended to be a complete one, but it is obvious that many hundreds of tons of steel covered by A.S.T.M. standards are going into this huge plant.

The Standard Oil Development Co. has been affiliated with A.S.T.M. for many years, and its personnel is active in the work of many A.S.T.M. technical committees.

Material	A.S.T.M. Specification
Structural steel	A 7
Cast iron for access doors, bell caps	A 48
Cast alloy steel tube supports	A 222
Cast steel return headers	A 95
Steel plate	A 10
Steel tubes	A 106
Steel for vessels	A 70
Steel forgings	A 181
Bolts and studs	A 193
Naval brass boiler tube sheets	B 171

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sumers, producers, and general interest. Thus they constitute a forum so organized that all sides of a given question or problem can be thoroughly explored and evaluated.

The advent of steel introduced an astonishing diversity of ferrous materials and made available to commerce and industry the most important group of engineering materials the world has known. Technical progress was rapid in the early days, and in order that the users could apply steel to the best advantage it was natural for them to seek information from men who made steel.

Fundamental information is made available most efficiently through organizations of technical men and professional men. Thus the Iron and Steel Institute of Britain was established in 1869, and the Association of American Steel Manufacturers was organized at Pittsburgh, Pa., in 1894.

The American Iron and Steel Institute, formed in 1908, eventually took over the American Iron and Steel Association of Philadelphia, and the Association of American Steel Manufacturers Technical Committees. The Institute, rather than formulate specifications themselves, have cooperated with the specification-writing committees of other societies and governmental agencies.

The emergency of World War II made us realize that a comprehensive job of simplification and standardization had to be done to conserve materials to preserve our national economy and to assure our survival as a nation. An important part of this program was the simplification and standardization of steel grades. By this time there were virtually thousands of steel compositions in use. Many of them varied from one another in respect to chemical compositions by amounts so small as to have no metallurgical or engineering significance.

The number was reduced to slightly over two hundred and at the same time cover the entire useful metallurgical and mechanical field for engineering and constructional steel bars. That work was accomplished with the cooperation of the American Iron and Steel Institute, Society of Automotive Engineers, the Army Ordnance Department, the Bureau of Ships of the Navy Department, and the American Society for Testing Materials.

As is true with all engineering standards, this work of simplification and standardization can never be considered as finished. Industrial and economic progress will bring about changes and introduce new problems which will need continuing attention.

The ability of a given steel commodity to give proper service is not forecast by its grade or chemical composition alone. In addition to its grade, as indicated by chemical analysis or tensile strength, there is the other equally important factor of quality. For instance, there are currently manufactured a number of qualities in steel plates, each of which may be similar in grade, for example 60,000 psi. tensile strength, but varying profoundly in quality. Although tensile strength may be identical, tank quality plates could never do the work of locomotive firebox quality.

Thus indeed the following, written by Glanvill in 1650, still holds good today:

"Iron se ms a simple metal. But in its very nature are many mysteries and men who bend to them their minds, shall in arriving days gather therefrom great profit not to themselves alone but to all mankind."

Testing and the Federal Trade Commission[1]

By Henry Miller, Director of Trade Practice Conferences, Federal Trade Commission

LABORATORY testing must frequently be employed in the work of the Federal Trade Commission, which is directed to the prevention of unfair methods of competition and unfair or deceptive practices in the sale and distribution of products in interstate commerce.

The Commission does not have a laboratory to make its own tests, but it obtains such laboratory services from the National Bureau of Standards, and other agencies, including technical research and test data which may be available in industry and from scientific organizations such as the A.S.T.M.

Laboratory analysis and methods of tests are used in search for the truth necessary to determining the propriety of advertising, labeling, or selling claims. While such technical service is employed in relation to the many types of products, the field of textiles embraces perhaps the largest single category of products respecting which we must call upon the laboratory.

In the so-called compl int case proceedings, which are based upon allegations of specific advertising, labeling, or selling claims, alleged to be false or deceptive, analyses and tests are frequently made of articles bought in the open market. The type of information needed relates, for the most part, either to content of the article or to performance. To mention a common example, if a fabric is advertised or labeled as containing a certain fiber, or as containing that fiber in a certain proportion, and the question is whether or not such advertisement is truthful and nondeceptive, it immediately becomes necessary to determine whether the fiber in question is in fact present as claimed, or whether the amount of it present is as claimed. That is illustrative of the more simple type of laboratory testing or analysis which is frequently required, for which we quite often call upon the National Bureau of Standards.

Selling claims as to performance are in still another category, and laboratory testing is resorted to as either a necessary or helpful means of determining the fact as to truth or falsity of the claim.

Test methods also enter extensively into the Commission's trade practice rule work. In such instances the test method is directed not only to throwing light on the question of whether a specific type of advertising claim is deceptive or misleading, as is involved in violation cases, but also test methods are specified as a means of providing industry with a basic guide for scrutinizing their own advertising and selling claims and to provide assurance that certain testing or test methods will be officially accepted as reliable and adequate. An example of this is found in the trade practice rules respecting shrinkage of woven cotton yard goods. These rules provide a guide to the conditions under which the usual shrinkage representations will be deemed proper or, on the other hand, beyond the pale of propriety. For determining the factual inforr ation upon which to base such claims, the test method prescribed in Commercial Standard 59-39 is recognized and accepted as adequate.

Federal Trade Commission proceedings are required by law to be directed to the protection of the interest of the public. Such public interest embraces not only protection of purchasers but also protection of scrupulous business through fair competition. In this broad public interest involving the propriety of advertising or selling claims, such claims must be viewed from the standpoint of their effect upon the purchasers to which the selling appeal is made. An advertisement, to be technically true, is not sufficient if its implications are misleading or if its general interpretation by the buying public is not wholly in accord with the facts. These considerations provide a guide as to the type of test methods which are desirable as providing adequate reliance in the determination of unfair methods of competition and unfair or deceptive acts or practices. In other words, the method of testing and the results obtained from such methods should be in reasonable correlation with the actual conditions encountered by the consuming public. The proper test method should produce results that are realistic and provide reasonably an effective evaluation of conditions obtainable in actual use of the article. Thus, for example, in testing the performance of a certain type of garment the test will be of little value unless it is sufficiently correlated with actual conditions which the consumer will encounter in wearing the garment.

In our trade practice conference rule work, particularly in the textile field, laboratory research and testing techniques are increasing in importance. There are several pending trade practice conference proceedings in which laboratory methods for evaluating performance loom as the main problem to be solved.

The proceedings for the trade practice rules regarding wool shrinkage and the proceeding in respect to rainwear are illustrative of pending work in which test methods are of great importance and on which the best thought of all concerned is needed in finding a solution that will adequately protect the public and be equitable and fair to the host

[1] Presented at the meeting of A.S.T.M. Committee D-13 on Textile Materials, October 14, 1948, Washington, D. C.

of manufacturers, distributors, and dealers concerned. In these proceedings, as in others, the tremendous volume of research and conscientious effort expended on the subject of laboratory analysis and test methods by industry organizations such as the A.S.T.M. has been most helpful to us. We are grateful for this service and for all the conscientious effort that has been put into the various projects by members of industry and their technical staffs to serve the general public interest.

Change in Publications to Student Members

THE greatly increased size of some of the special compilations of standards, any one of which heretofore could be requested without charge by student members, has necessitated a change in the method of furnishing these special compilations to the students. The Society has always had a very liberal policy in effect in connection with the material sent to its student members, and except for the special compilations of standards no other changes are being made. The dues of $2 per year are to remain unchanged. A list of publications which student members will receive is as follows:

ASTM BULLETIN
Index to Standards
Annual meeting preprints (on request)
Year Book (on request *only*)
Special Compilation of Standards for Engineering Students (on request)
or
At an extra nominal charge any one of the special compilations of standards.

The Special Compilation of Standards for Engineering Students referred to is a 280-page book with selected specifications and tests. This so-called "student pamphlet" is very widely used in engineering courses, particularly as a text or a reference in courses involving testing laboratory, mechanics of materials, and related subjects. Several thousand copies are distributed yearly, the price to students being 75 cents.

The prices to be established for the other special compilations of standards, which cover such fields as petroleum, cement, coal, and coke, etc., are being studied and will be listed in the student's membership application blank, copies of which are available on request.

The officers of the Society are most anxious to have a large and active group of student members, and the low dues coupled with the extensive publications furnished are maintained to make student membership attractive.

These illustrations show some of the textile testing and research laboratories visited by Dr. W. D. Appel, Chief, Textile Section, National Bureau of Standards when he attended the Buxton meeting of ISO Technical Committee 38 on Textiles last year. His interesting paper "Observations on Textile Standardization in Europe" appeared in the January ASTM BULLETIN, page 29. We are indebted to Dr. Appel and his "trusty" camera for these and other illustrations. At the meeting of Committee D-13 on Textiles in Washington in October, 1948 he gave an interesting illustrated lecture covering his visits to centers of textile research and testing in Europe.—Upper right, Leeds University, Leeds, England; Upper left, Wool Industries Research Association, Leeds, England; Lower right, Linen Industry Research Association, Belfast, Ireland; Lower left, The Fiber Institute, Delft, Netherlands.

Additional Sustaining Members

WE ARE pleased to announce the addition of two A.S.T.M. Sustaining Members. In each case the companies noted have transferred to the sustaining class from their previously held company memberships. These companies and their representatives are as follows:

DOMINION BRIDGE CO., LTD., Montreal, Canada (Member since 1904)—A. S. Wall, Plate and Boiler Engineer.
MID-CONTINENT PETROLEUM CORP., Tulsa, Okla. (Member since 1917)—H. T. Bennett, Chief Chemist. (Representative on Committee D-2, W. L. Thompson.)

Organizations which are interested in the advantages of the Sustaining Membership class may write to A.S.T.M. Headquarters, and details will be sent promptly.

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RACE STREET
PHILADELPHIA 3, PENNA.

1948 *Proceedings*

The 1948 A.S.T.M. *Proceedings*, Vol. 48, comprise 1354 pages, and include all of the Annual Reports of the committees, and the large number of technical papers presented at the Detroit Annual Meeting. The first 525 pages of this volume, which is distributed to all members, are devoted to committee reports together with the appended items which include some special papers and discussions, and a number of test methods and such items published for information and comment. This portion of the *Proceedings* also includes the Annual Address by President T. A. Boyd entitled "If Dr. Marburg Came Back Today," and the Board of Directors Annual Report.

The section on technical papers begins on page 527; the Edgar Marburg Lecture by Dr. Paul C. Aebersold entitled "Isotopes and Their Application in the Field of Industrial Materials" being the first item, followed by papers on metals, then in turn by certain papers and discussions on cement, concrete aggregates; following them are contributions on petroleum products, rubber, plastics, paints, textiles; and miscellaneous items follow.

Symposiums which are published in full in the *Proceedings* cover the following subjects: "Usefulness and Limitations of Samples"; "Deformation of Metals as Related to Forming and Service";[1] "Panel Discussion on the Influence of Non-Ferrous Metals and Their Compounds on the Corrosion of Pressure Vessels"; "Methods and Procedures Used in Identifying Reactive Materials in Concrete"; and "Speed of Testing."

Following is a list of the papers which were not distributed as preprints before the Annual Meeting. An asterisk indicates the items that were printed in advance of the *Proceedings* during the past few weeks.

Nonmembers of the Society may purchase the *Proceedings* at $12 per copy, in blue cloth binding and members can procure *extra* copies at $8.

[1] A Review of the Tin Situation—Marshall W. Tuthill
[1] Tension Testing of Magnesium Alloy Tubing—A. A. Moore
[1] Stability of Steels as Affected by Temperature (Project No. 29)—Prepared by J. J. Kanter and E. A. Sticha
* High-Temperature Properties of Rotor Disks for Gas Turbines as Affected by Variables in Processing—H. C. Cross, Ward F. Simmons, J. W. Freeman, and E. E. Reynolds
* An Investigation of the Possibilities of Organic Coatings for the Prevention of Premature Corrosion-Fatigue Failures in Steel—Robert C. McMaster
* Some Aspects of the Effect of Metallurgical Structure on Fatigue Strength and Notch-Sensitivity of Steel—T. J. Dolan and C. S. Yen
* Fatigue and Static Load Tests of an Austenitic Cast Iron at Elevated Temperatures—W. Leighton Collins
* Tensile, Creep, and Fatigue Properties at Elevated Temperatures of Some Magnesium-Base Alloys—John C. McDonald
* An Hypothesis for the Determination of Accumulative Damage in Fatigue—F. E. Richard, Jr., and N. M. Newmark
Changes Found on Reciprocated Steel, Chromium Plate, and Cast Iron Sliding Surfaces—J. N. Good and Douglas Godfrey
* The Spectrochemical Analysis of Cements and Other Mineral Products—M. F. Hasler, C. E. Harvey, and F. W. Barley
The Effect of Repeated Loading on the Bond Strength of Concrete—Supplement II—C. W. Muhlenbruch
* Research on Concrete Durability as Affected by Coarse Aggregate—Harold S. Sweet
The Effect of Temperature on the Creep of Two Laminated Plastics as Interpreted by the Hyperbolic-Sine Law and Activation Energy Theory—W. N. Findley, W. J. Worley, and C. N. Adams
* The Determination of Limits for the Control of Placement Moisture in High Rolled-Earth Dams—W. G. Holtz
* The Importance and Practical Use of Relative Density in Soil Mechanics—D. M. Burmister
* Measurement of the Reactivity of Solid Fuels by the Crossing-Point Method—J. Jonakin, P. Cohen, R. Corey, and B. Jain

[1] Appended to Committee Reports.
* Printed separately in advance of *Proceedings*, but not preprinted before annual meeting.

Federation Activities on Paint

The Federation of Paint and Varnish Production Clubs has approved a number of A.S.T.M. test methods, and has developed two additional procedures which are in process of study by A.S.T.M. Committee D-1 on Paint, Varnish, Lacquer, and Related Materials. A list of the A.S.T.M. and Federation designations and titles follows:

Federation Designation	Method Covers	A.S.T.M. Designation
1-32	Tinting Strength of White Pigments	D 332 - 36
2-32	Mass Color and Tinting Strength of Color Pigments	D 387 - 36
3-39	Evaluating Degree of Resistance to Rust Obtained with Paint on Iron or Steel Surfaces	D 610 - 43
4-39	Evaluating Degree of Chalking of Exterior Paints of the Linseed Oil Type	D 659 - 44
5-39	Evaluating Degree of Checking of Exterior Paints of the Linseed Oil Type	D 660 - 44
6-39	Degree of Cracking of Exterior Paints of the Linseed Oil Type	D 661- 44
7-39	Evaluating Degree of Erosion of Exterior Paints of the Linseed Oil Type	D 662 - 44
8-39	Evaluating Degree of Flaking (Scaling) of Exterior Paints of the Linseed Oil Type	D 772 - 47
9-47	Permeability to Moisture of Organic Surface Coatings	......
10-48	Fineness of Dispersion of Pigmented Protective or Decorative Coatings	......
11-48	Flash Point by Means of the Tag Closed Cup	D 56 - 36
12-48	Distillation of Gasoline, Naphtha, Kerosene, and Similar Petroleum Products	D 86 - 46

Copies of the A.S.T.M. standards can be obtained from A.S.T.M. Headquarters and the two Federation designations can be procured from the Federation Office, 1524 Chestnut St., Philadelphia 2, Pa. The price of the A.S.T.M. and the Federation standards is 25 cents per copy.

By-laws Change Proposed on Honorary Memberships

As currently in effect the By-laws, in Article I, Section 7, provide that the number of Honorary Members shall not exceed twenty, and it is proposed that this be changed to read "the number of Honorary Members shall be left to the discretion of the Board."

For many years the number of Honorary Members was restricted to ten, but later as the Society increased greatly in membership, and the scope of its work became much more ramified, a change was thought desirable, and the number was put at twenty. It is now felt that the number of men whom it is fitting to honor through this class of membership should be left to the discretion of the Board, and this change is therefore recommended. It is the feeling that the Board is competent to evaluate an appropriate number and will be alert to the recommendations.

The By-laws provide that an Honorary Member shall be a person of widely recognized eminence in some part of the field which A.S.T.M. covers, or one who has rendered especially meritorious service to the Society. Nominees are proposed to the Board of Directors by at least ten members, and the Board elects, a unanimous vote being required.

Financial Highlights—Calendar Year 1948

Notes on 1949 Budget

At the January meeting of the Board of Directors each year the Executive Secretary submits a detailed report on the Society's financial operations during the preceding calendar year and it is at this meeting that the Board acts on the Finance Committee's recommendations for the current year's budget operations. A detailed report of the Society's financial condition is always given in the Annual Report of the Board of Directors presented at the Annual Meeting in June, but it is believed a number of highlights of the Executive Secretary's report to the Board at the January, 1949, session will be of interest to the members and that is the purpose of what is presented here.

1948 Operating Receipts:

The accompanying table shows the operating receipts for the past three calendar years. This indicates that there was a marked increase in the Society's income, but it will also be apparent from the companion table showing disbursements that the necessary expenditures were much greater also.

The receipts from dues, almost $200,000, are about $55,000 higher than for the previous year, a reflection of the increase in dues which became effective January 1, 1948. The Board on different occasions has expressed gratification at the reception which the members, particularly the company and sustaining members, have given to the increase in dues. The higher dues, together with the notable increase in receipts from sales of publications, have enabled the Society to show an encouraging favorable balance at the end of the year, as noted below.

1948 Operating Disbursements:

This table shows that for the past calendar year total disbursements were almost $460,000, with the cost of publications the largest item, as has been the case for many years. Along with virtually every other organization the Society has experienced greater costs of operations, and increases in printing costs have had to be accepted. The table notes that the percentage of total disbursements represented by salaries has remained virtually constant. The total is higher because of certain increases in the salary scale and because of increases in the staff, there being five new staff additions in 1948.

Operating Surplus:

A comparison of the tables will indicate that for 1948 there was an operating surplus of just over $61,000, which is extremely encouraging from two standpoints; *first*, it balances out two previous years' operating deficits, and, *second*, it presents a somewhat more optimistic view of the *operating deficit* which the Board has had to budget for the calendar year 1949.

In considering favorable operating balances or deficits it is a matter of concern to the Board that it has not been possible to build up what is considered a satisfactory ratio of surplus to operating disbursements. While no specific figure can be stated, it is felt by the Board that the Society's surplus should, for a really sound financial condition, represent about a year's disbursements. The surplus at the end of 1948 was just 50 per cent of the year's operations. The percentage ratio of surplus to disbursements has ranged in the past ten years from 38 to 60 per cent.

1949 Budget

In considering the budget for 1949, current income was placed at $488,000, made up of total dues and entrance fees of $207,000, publications sales, $237,500, miscellaneous items, $43,500. Estimated disbursements are $521,250, made up of publication costs of $213,750; salaries, including staff expansion, about $183,000; and general office expenses, technical committee and meeting expenses, headquarters and miscellaneous, $124,500. To balance the budget, it will be necessary to draw on surplus for

OPERATING RECEIPTS

Source	1948		1947		1946	
		Per Cent		Per Cent		Per Cent
Dues	$199 892	38.6	$144 431	33.7	$136 877	43.9
Sales of Publications	269 952	51.5	251 708	58.8	142 231	45.5
Miscellaneous						
Advertising	19 750	...	17 046	...	17 055	...
Interest and Dividends	6 991	...	6 968	...	6 034	...
Registration Fees	6 623	...	5 054	...	3 721	...
Exhibit	9 665	...	......	...	5 371	...
Total Miscellaneous	50 711	9.9	31 925	7.5	32 975	10.6
Total Receipts	$520 555	100	$428 064	100	$312 083	100

OPERATING DISBURSEMENTS.

Item	1948		1947		1946	
		Per Cent		Per Cent		Per Cent
Publications	$196 880	42.8	$195 617	45.4	$128 519	37.8
Salaries	154 274	33.6	144 601	33.6	122 464	36.0
General Office Expense	40 910	8.9	33 925	7.9	28 166	8.3
Meetings and Technical and District Committees	26 890	5.8	21 545	5.0	19 304	5.7
Headquarters Occupancy	17 267	3.8	14 013	3.3	11 218	3.3
Miscellaneous, Including Retirement	23 206	5.1	20 696	4.8	30 323[a]	8.9
Total	$459 427	100	$430 397	100	$339 994	100

[a] Including $10,600 for furniture and fixtures and for new equipment for the new Headquarters building, which the Society occupied in 1946.

OPERATING BALANCE OR DEFICIT.

1946	−$27 911
1947	− 2 333
1948	+ 61 127

some $33,250 which is a normal procedure for the third year in the pattern of three-year budgeting necessitated by the triennial appearance of the Book of Standards.

The Finance Committee will, as usual, review receipts and disbursements at its quarterly meetings and will make such modifications in the budget as seem to be required. The year 1949 has a number of uncertainties, and while the budget for income and for expenditures is based on very conservative figures the Executive Secretary and the Finance Committee will give continuing scrutiny to all factors involved.

One important factor in the 1949 operations involves the membership growth, and it is hoped that each member will, where feasible, aid the Board's Membership Committee in gaining new members.

Use of the Headquarters Building for Meetings

As many of the members who have attended meetings here know, extensive use is being made of the Headquarter's building for A.S.T.M. committee meetings. Two rooms, the board room, which can accommodate as many as fifty, and can also be divided into two separate rooms, and the committee room, which can accommodate twenty, are used exclusively for this purpose. A total of ninety-three separate committee meetings and conferences were held in the building during 1948 including four committees of other organizations to whom we are always pleased to extend this courtesy.

Visitors to headquarters have been generous in their compliments, and the members who have used the various facilities, frequently express their gratification in the Society's having such a fine building of its own as its headquarters. While we could wish that the facilities for committee meetings were greater, it is pleasing to know that many committees and other groups in the Society like to meet with us and feel that their meetings here are quite successful.

Part—1948 Supplement	Pages	Number of Standards and Tentatives	Tentatives Adopted But Not Published[a]	Published for the First Time
I-A, Ferrous Metals	274	34	1	6
I-B, Non-Ferrous Metals	306	60	11	11
II, Nonmetallic Materials (Constructional)	300	77	15	21
IIIA, Fuels, Petroleums, Aromatic Hydrocarbons, Soaps, Water Textiles	424	56	4	13
IIIB, Electrical Insulation, Plastics, Rubber, Shipping Containers, Paper, Adhesives	346	58	2	24

[a] Tentatives which are adopted as standard without change are not published in full in the Supplements but titles are listed with reference to the original source.

Book of Standards Supplements Issued

A 1948 Supplement to each part of the 1946 Book of Standards has been issued, and these books bound in heavy paper cover have been mailed to the members in accordance with the instructions on file at Headquarters. All told there are 1644 pages in the five 1948 Supplements, and a total of 285 new or revised specifications and tests.

These Supplements are available for purchase by nonmembers at $4 each, all five totaling $20. Members can procure extra copies of any or all the books at $3 per copy, total for all five, $15.

In the 1946 Book of Standards, and in the 1947 and 1948 Supplements, and the 1946 Book of Chemical Analysis of Metals there are given the 939 standards and 556 tentatives now in effect.

With the Supplement are yellow stickers, which when attached to the respective portions of the original Book of Standards, and 1947 Supplements, will call attention to any standards or tentatives which have been superseded or revised.

Schedule of A.S.T.M. Meetings

Date	Group	Place
March 22	Philadelphia District Meeting	Philadelphia, Pa.
March 22–23	Committee D-20 on Plastics	Washington, D. C.
March 22–23	Committee D-12 on Soaps and Other Detergents	New York, N. Y.
March 23–25	Committee D-9 on Electric Insulating Materials	Washington, D. C.
March 25	Northern California District	San Francisco, Calif.
April 5	New York District	New York, N. Y.
April 12	Executive Committee of Board of Directors	(A.S.T.M. Headquarters)
April 13	Administrative Committee on Research	(A.S.T.M. Headquarters)
April 14	New England District	M.I.T., Cambridge, Mass.
April 21	Committee E-1 on Methods of Testing	(A.S.T.M. Headquarters)
May 4	Pittsburgh District	Pittsburgh, Pa.
May 9	Board of Directors	(A.S.T.M. Headquarters)
May 9–10	Committee D-10 on Shipping Containers	Atlantic City, N. J.
June 27–July 1	1949 Annual Meeting	Atlantic City, N. J.
October 10–14	1949 West Coast Meeting	San Francisco, Calif.

New Staff Member—John S. Pettibone

John S. Pettibone, Moorestown, N. J., has become a member of the Headquarters Staff, and will concentrate his work on the expanded corrosion test activities described elsewhere in this Bulletin. In addition to supervising the test sites that are to be established, and the placing of the specimens, and coordinating many of these activities, he will devote some of his time to other technical work at Headquarters, thus giving some relief to the current staff which is concerned with technical committee contacts, technical editing, and related matters.

Following studies at Lehigh University where he majored in Chemical Engineering with later extension work at Temple University and the University of Tennessee, Mr. Pettibone has had varied experience in the industrial fields of metals and chemical manufacturing. He has been successively a metallographer; later in the research department of one of the larger petroleum refineries; and he was a supervisor in one of the du Pont plants. His work also has involved service with the Tennessee Eastman Corp. at Oak Ridge, involving uranium isotopes, and he has experience in connection with the manufacture of soaps and detergents, and the processing of sulfur for fungicides.

Mr. Pettibone, who is married, with two small children, has been spending several weeks at Headquarters getting oriented. In his work he will report through the Technical Secretary.

DISTRICT ACTIVITIES

Notes on District Meetings

Some Past, Some Future

RECENTLY several of the districts have held interesting meetings, and at two of these, President R. L. Templin has been the feature speaker. In New York on February 3, and in Detroit on the 21st, he gave his interesting talk on Aluminum. In New York, it was slanted to applications in machine design, since this meeting was a joint one with the Machine Design Division, of the A.S.M.E. Metropolitan Section. In Detroit he gave his basic address involving some history, economics, various developments, and covered applications in some detail.

Following each of these meetings there was an interesting discussion period where he answered numerous questions.

In New York, through the courtesy of the Aluminum Company of America, there was shown the industrial film, "From Mine to Metal." In Detroit, preceding the President's paper, there was a short talk by Austin Grant, Detroit newspaper man and commentator.

The attendance in New York was about 150, and in Detroit 225.

Philadelphia Symposium on Industrial Quality Control

This meeting, under the joint auspices of the Philadelphia District, and the Philadelphia Section of the American Society for Quality Control, will no doubt be rated as the top district affair of the year. With four technical speakers and General Donald Armstrong, President, U. S. Pipe & Foundry Co., giving the address at the dinner, the meeting was also marked by a very heavy attendance. At the afternoon session there were at least 350, and the audience swelled to a dinner and evening session attendance of over 400. The program was as follows:

Organizing for Quality and Waste Control, Eugene H. MacNiece, Director of Quality Control, Johnson & Johnson, New Brunswick, N. J.

Study of Process Capabilities and Application at the Foreman's Level, Anthony Oladko, Foreman, Adhesive Plaster Mill, Johnson & Johnson, New Brunswick, N. J.

DINNER

The Executive Looks at Quality Control, General Donald Armstrong, President, U. S. Pipe & Foundry Co., Burlington, N. J.

Mobilizing for Quality Control, J. M. Juran, Professor and Chairman, Department of Administrative Engineering, New York University; Consultant Management Engineer

Lecture and Training Film on Quality Control, Simon Collier, Director of Quality Control, Johns-Manville Corp., New York, N. Y.

Although the difficulty of presenting adequate condensed abstracts prevents publicizing any details or points covered by the speakers, each paper was well presented, and the consensus at the close of the meetings was that each had done his assigned task in excellent fashion. General Armstrong made a strong plea for appreciation of the value of quality control, and gave examples from his long army career and his later work in industry on the value of this field of endeavor. H. W. Stuart, Director of Quality Control, U. S. Pipe & Foundry Co., a member of both A.S.T.M. and A.S.Q.C., merits particular commendation for planning and carrying through the technical program, and also for many efforts to make the meeting a success. Operating with him was Charles R. Scott, Jr., of S.K.F. Industries, Chairman of the A.S.Q.C. Philadelphia Section. These two men were Technical Chairmen of the afternoon and evening sessions. A. O. Schaefer, Chairman of the Philadelphia District, A.S.T.M., now Assistant to the Executive Vice-President, The Midvale Co., was Toastmaster at the dinner.

While many of those concerned with quality control may know about publications prepared by two of the speakers, since there were numerous references to them all in a very complimentary note, it is appropriate to note them here. Funk and Wagnalls Co., in New York, has published Mr. MacNiece's 76-page discussion on "Organizing for Quality and Waste Control," this being part of a Reading Course in Executive Technique. Chapter headings include the following:

I. Scope and Limitations; II. Fundamentals of Organizing for Control; III. Sampling for Raw-Materials Control; IV. Control Charts; V. Cooperation with Research; VI. Controlling Process Waste. A short Bibliography is given.

The book by Professor Juran is entitled "Management of Inspection and Quality Control," and is published by Harper Brothers in New York.

Meetings to Come

In Los Angeles on March 15, and in San Francisco on March 25, President Templin is speaking on "The Determination and Significance of the Mechanical Properties of Metals," and Executive Secretary C. L. Warwick is on the program for an informal talk on "Trends in Materials Testing and Research."

In Rochester on March 10, Eugene Ayres, Gulf Research & Development Co., Pittsburgh, is discussing "Major Sources of Energy." This meeting is being sponsored by the Western New York-Ontario District in cooperation with the Rochester Engineering Society, and the Rochester Section, The A.S.M.E.

Mr. Ayres will also give this same talk at the meeting sponsored by the New York District in the Engineering Societies Building, on Tuesday, April 5. This meeting will get under way at 7:30 p.m., in Room 501.

On March 22 at the Franklin Institute, Philadelphia, two prominent men will discuss Industrial Stream Pollution. Dr. Norris W. Vaux, Secretary of Health, Commonwealth of Penna., will discuss "The Problem," and W. B. Hart, Service Superintendent, Atlantic Refining Co., will outline "The Cure." This topic is of intense interest all over the country, and Philadelphia is fortunate to have these men participate in its meeting.

The New England District is having a three-paper session on the topic of Light Metals and Alloys, at M.I.T. in Cambridge, on April 14. President Templin will discuss Aluminum, Dr. Bruce Gonser of Battelle, will point out interesting aspects of Titanium, and a representative of the Magnesium industry will present information and data on that metal and its alloys.

The Pittsburgh District on April 29 is having a Smoker and Social Hour, at which the guest of honor will be President Templin, at home in his own district. This affair is to be at the University Club. The Pittsburgh Council has felt that a gathering of this kind would provide an opportunity for members really to get acquainted.

All members and their friends and associates are cordially invited to attend any of these district affairs. Direct mail announcements go to the members in the respective districts, and usually announcements go to the membership of some of the other local societies and groups who should be interested in the topics covered.

Speakers' Table at Philadelphia Quality Control Dinner. From left to right. Tinius Olsen, 2nd, District Secretary; Wm. J. Masser, General Electric Co., A.S.Q.C. Secretary; Eugene H. MacNiece, Johnson & Johnson; Charles R. Scott, Jr., S.K.F. Ind., A.S.Q.C. Chairman; General Donald Armstrong, U. S. Pipe & Foundry; A. O. Schaefer, District Chairman.

Districts to Nominate Councilors; Reports Due

THE Charter governing the A.S.T.M. Districts provides that by April 1 of each year a Nominating Committee shall have met and reported nominations for offices, the terms for which expire at the next annual meeting of the Society. This year no action is required on the offices of Chairman, Vice-Chairmen, and Secretary, since these elections are always held in the even-numbered years, but the terms of approximately half of the Councilors will expire at the close of the 1949 annual meeting. Each district is now in course of appointing a nominating committee. The provisions are that this committee shall consist of five members headed by the immediate past-chairman of the council if available, one other councilor, and three members at large. The Manual for A.S.T.M. Districts points out that it is well to have a number of the major industries in the district represented on the council, and that the council should be a well-diversified one, possibly with new men being added each year to spread responsibility and also to bring in new viewpoints.

The mechanics for election of officers provide that a ballot is distributed to all of the respective district members before May 25 of each year. Provision appears on each ballot for writing in additional names for membership on the council.

Annual Reports:

To simplify the submission of Annual District Reports to the Board of Directors, the Administrative Committee on District Activities has this year prepared a return questionnaire form noting a number of the important points on which the districts should comment. The purpose of this return form is to make it somewhat less burdensome for the officers to prepare the reports, and also to expedite the submission of the material which is reviewed by the Administrative Committee on District Activities, and then referred to the Board of Directors. These reports must be at A.S.T.M. Headquarters by April 1. Direct communications on these various matters have been sent to all district officers.

V. J. Altieri Dies Suddenly

WHILE the necrology section of this BULLETIN notes the sudden death of V. J. Altieri, Chairman of the New England District, it seems appropriate to acknowledge his intensive efforts on behalf of the New England Council in this portion of the BULLETIN devoted to district affairs. Mr. Altieri had been active in A.S.T.M. work for a number of years and was an authority on the subject of gaseous fuels, and a few years back had edited a voluminous text on this subject. He had been a member of the New England District Council from its inception, and was vice-chairman until his election to the chairmanship in June, 1948.

In the Council, his driving energy and enthusiasm were always apparent, and a number of accomplishments of the New England District are, in considerable measure, due to his ideas and enthusiasm.

TECHNICAL COMMITTEE NOTES

Scope and Personnel of New Technical Committee on Ceramic Whitewares

Committee C-21 to Work in Cooperation with Whitewares Division of the American Ceramic Society

A NEW A.S.T.M. technical committee, Committee C-21 on Ceramic Whitewares, was organized in October, 1948. Since then the personnel has been appointed, agreement has been reached on a statement of scope, and several subcommittees have been established.

Scope and Subcommittees:

The scope of the committee will include all types of ceramic whitewares including sanitary ware, electrical porcelain, chemical porcelain, stoneware, dinnerware, and ceramic tile. The proposed scope reads as follows:

"To stimulate the research and formulation of definitions, methods of tests and specifications pertaining to ceramic whitewares."

The committee membership includes not only representatives of manufacturers and users of the products but also suppliers of the basic materials as well as general interest members from several universities. The early activity of the committee will deal for the most part with methods of tests and with nomenclature and definitions of terms.

The committee will work in cooperation with the existing Whitewares Division of the American Ceramic Society, much in the same manner that A.S.T.M. Committee C-8 on Refractories is doing in its field. Rapid progress is being made in placing this committee on a working basis through the energetic efforts of its Chairman, Dr. J. H. Koenig, Director of the School of Ceramics, Rutgers University, and an Executive Subcommittee composed of J. R. Beam, Universal-Rundle Co. (Vice-Chairman), R. F. Geller, National Bureau of Standards (Secretary); Ralston Russell, Ohio State University; J. W. Hepplewhite, Edwin M. Knowles China Co.; C. G. Harman, Battelle Memorial Institution; and F. P. Hall, Pass & Seymour.

Four subcommittees have been organized as follows:

Subcommittee I—Executive
Subcommittee II—Nomenclature
Subcommittee III—Tests and Specifications
Subcommittee IV—Research

The Subcommittee on Nomenclature will be concerned not only with the

Philadelphia Quality Control, Speakers' Table. From left to right. C. L. Warwick, Executive Secretary, A.S.T.M.; H. W. Stuart, U. S. Pipe & Foundry; Simon Collier, Johns-Manville Corp.; W. Ralph Reeves, R.C.A., A.S.Q.C. Vice-Chairman; Anthony Oladko, Johnson & Johnson; E. K. Spring, District Vice-Chairman; Colonel C. R. Ritchie, U. S. Pipe & Foundry; Stanley S. Hart, Esterbrook Pen Co., A.S.Q.C. Treasurer.

preparation of definitions of terms required in the formulation of standards but also in the development of a comprehensive glossary of terms for the industry. The Subcommittee on Tests and Specifications has subdivided its organization into three sections covering raw materials, processing controls, and finished products. The Subcommittee on Research will promote basic and other research not covered or beyond the scope of the other subcommittees as well as to coordinate all research within the committee.

Personnel:

The personnel of Committee C-21 follows, with classification shown—Producer (P), Consumer (C), and General Interest (GI).

Chairman: J. H. Koenig, School of Ceramics, Rutgers University, New Brunswick, N. J.
Vice-Chairman: James R. Beam, Universal Sanitary Mfg. Co., New Castle, Pa.
Secretary: R. F. Geller, Ceramic Division, National Bureau of Standards, Washington 25, D. C.

CLASSIFICATION

P A. C. Spark Plug Co., Karl Schwartzalder
C American Hospital Association, L. P. Goudy
C American Institute of Architects, Theodore Irving Coe
P American Lava Corp., S. J. McDowell, H. Thurnauer
P R. E. Anderson, Robertson Mfg. Co.
GI Armour Research Foundation, R. S. Olsen
GI Battelle Memorial Institution, C. G. Harman
GI Bell Telephone Labs., M. D. Rigterink
GI G. A. Bole, Ohio State University
P R. B. Carothers, H. C. Spinks Clay Co.
P Champion Spark Plug Co., Frank H. Riddle
GI Committee D-9 on Elec. Insulating Materials, K. G. Coutlee
P C. H. Commons, Jr., Locke Insulator Co.
P Electric Auto-Lite Co., Robert Twells
P I. J. Fairchild, Vitreous China Plumbing Fixtures
C Alexander Finlayson, Pacific Car & Foundry Co.
P General Ceramics & Steatite Corp., C. L. Snyder
P General Electric Co., Kenneth W. Cermak
P Gladding-McBean & Co., W. O. Brandt
P Gypsum Assn., C. E. Abbey
P Donald Hagar, Zanesville, Ohio
P F. P. Hall, Pass & Seymour
GI Dr. E. C. Henry, Pennsylvania State College
P J. W. Hepplewhite, Edwin M. Knowles China Co., and U. S. Potters Assn.
C Housing & Home Finance Agency, V. T. Manus
P Wharton Jackson, Georgia Kaolin Co.
P J. M. Lucas, U. S. Stoneware Co.
P A. R. McMannis, U. S. Quarry Tile Co.
GI Prof. Lane Mitchell, Georgia School of Technology
P Mosaic Tile Co., D. J. Barbour
GI National Bureau of Standards, R. F. Geller
C National Elec. Mfgrs. Assn., J. M. Gilfallen
GI New York State College of Ceramics, R. M. Campbell
GI Ohio State University, C. J. Koenig
GI Edward Orton, Jr., Ceramic Foundation, L. J. Carruthers
P G. W. Phelps, United Clay Mines Corp.
P Fraser B. Rhodes, John Douglas Co.
GI Ralston Russell, Jr., Ohio State University
GI Rutgers University, J. H. Koenig
P E. Schramm, Onondaga Pottery Co.
C Sears, Roebuck & Co. W. D. Ford
P Shenango China Co., E. P. McNamara
P R. F. Sherwood, United Feldspar and Minerals Corp.
P H. A. Smith, Richmond Radiator Co.
C A. Frank Tesi, W. T. Grant & Co., and National Retail Drygoods Assn.
P Titanium Alloy Mfg. Co., W. J. Baldwin
GI U. S. Bureau of Mines, T. A. Kleinfelter
C U. S. Department of the Army, V. F. Payne, and Sam DiVita
C U. S. Department of the Navy, Bureau of Ships
C U. S. Department of the Navy, Roland D. Jackel
C U. S. Maritime Commission, Fred Hazelwood
GI U. S. Tariff Commission, W. W. Meyer
P Universal-Rundle Corp., James R. Beam, W. Keith McAfee
C Veterans Administration, W. R. Von Blon
GI Prof. A. S. Watts, Ohio State University
GI Ray T. Watkins, U. S. Tariff Commission
P Arthur A. Wells, Homer Laughlin China Co.
P Westinghouse Electric Corp., Harold C. Harrison
P R. L. Wolff, Centralab, Division of Globe-Union
GI Hewitt Wilson, Electrotechnical Laboratory, U. S. Bureau of Mines

News of New Committees on Acoustical Materials and Porcelain Enamel

AT the recent meeting of the Board of Directors it was indicated that considerable progress had been made toward the organization of the new Technical Committee C-20 on Acoustical Materials, this committee having been authorized late in 1948. Acoustical materials are interpreted as airborne sound-absorbing materials, which scope excludes materials in the field of vibration isolation and vibration damping.

Temporary officers of Committee C-20 have been appointed, the Chairman being H. A. Leedy of the Armour Research Foundation, and temporary Secretary, Hall J. Sabine of the Celotex Corp.

Suggested personnel for the committee is being studied, and various developments will be announced from time to time.

New Committee on Porcelain Enamel:

At various times in the past there have been suggestions that the importance of porcelain enamel and its widespread application with a variety of materials and for varied usages, would justify A.S.T.M. developing standard testing procedures, and also of establishing specifications. As a result of considerable correspondence with those interested, and based on a conference held at A.S.T.M. Headquarters in December, the Board of Directors has authorized a new technical committee on porcelain enamel with the *tentative* scope as follows:

"The formulation of definitions of terms, test methods, and specifications pertaining to those materials generally considered to be in the field of commercial porcelain enamel products."

Floor Waxes, Hard-Surfaced Flooring Materials, and Graphite Under Consideration for New A.S.T.M. Technical Committees

As a result of suggestions and discussions by consumers and producers of floor waxes, hard-finished flooring materials, and graphite, the Society, through its Committee on Standards and other groups such as the Administrative Committee on Ultimate Consumer Goods, is given intensive study to the desirability of undertaking standardization work. While no official decisions have yet been reached, the consensus on the part of many of those consulted seems to be that the Society could render real service in these fields.

While the value of the total annual production of these respective materials runs into millions of dollars, and for floor wax alone approaches possibly one hundred million dollars yearly, which is an indication of the extent of the industries and to some extent indicates their long establishment, there apparently is a dearth of recognized standard methods of evaluating the essential properties. Some of the properties involved in the evaluation of floor wax include toughness, lustre, hardness, drying time, settling properties, and the like; also water resistance, slip resistance, and resistance to other deteriorating influences.

There are quite a wide range of so-called hard-surfaced flooring materials including asphalt tile, plastic tile, rubber tile, cork, and linoleum.

Graphite finds a wide variety of uses in the lubricating field, in the electrical and the electronic industries, and it is available in various forms—amorphous, crystalline, flake, synthetic, etc.

In considering whether the Society should undertake standards work, and be prepared to undertake some research activities where insufficient data are available for the promulgation of tests, a well-established pattern is followed. Some responsible consumer or producer or groups of companies in these classifications approaches the Society to consider the need for standards; then the attitude of responsible individuals and committees in the Society that would be concerned is usually elicited, and before the Board of Directors receives specific recommendations there is a conference at which consumers and producers have a frank discussion of whether the problems are of sufficient importance to justify the considerable work that is usually involved. If there are real problems where it is felt A.S.T.M. can be of service and bring forth practical and usable standards or data, and it is evident that the work will receive the technical support of those concerned, the Board of Directors usually give the proposal their clear-cut affirmation.

While further announcement will be made concerning the progress of the studies now under way on the materials mentioned above, any members and others interested who would care to comment on any phases of the problems are invited to do so.

Nomenclature in Applied Spectroscopy to Be Covered by Joint Committee

Nomenclature and adequate definitions and terminology as applied to various fields of materials and technical subjects are extremely important, and the subject is one where frequently there is a mutual interest on the part of technical and trade organizations. Hence it is not surprising that A.S.T.M. through its Committee E-2 on Spectrographic Analysis, is joining with the Society for Applied Spectroscopy to form a Joint Committee on Nomenclature in this field. At its January meeting the A.S.T.M. Board of Directors approved this step. The following will serve on the Joint Committee:

The affiliation of members of the Committee is shown by letters, as follows: E = member of A.S.T.M. Committee E-2, S = member of Nomenclature Committee of Society for Applied Spectroscopy, L = liaison member.

Harold K. Hughes, *Chairman*, Socony-Vacuum Laboratories, Technical Service Dept. [ES]
R. Bowling Barnes, American Optical Co. [S]
Howard M. Bedell, National Spectrographic Laboratories [E]
Robert H. Bell, Lucius Pitkin, Inc. [ES]
Brooks A. Brice, Eastern Regional Laboratory, U. S. Department of Agriculture [E]
Wallace R. Brode, National Bureau of Standards [E]
George L. Buc, Calco Chemical Division, American Cyanamid Co. [S]
A. H. Canada, Consulting Engineering Laboratory, General Electric Co. (Infrared Applications Subcommittee, AIEE Electronics Committee) [L]
J. Raynor Churchill, Aluminum Research Laboratories [E]
Joseph Geffner, Joseph Geffner Co. [ES]
John Gilmore, Applied Research Laboratories [S]
Charles L. Guettel, Driver-Harris Co. [ES]
George R. Harrison, Massachusetts Institute of Technology [S]
Paul E. Lighty, Limestone Products Corp. of America, Limecrest Research Laboratories [ES]
Duane Roller, Department of Physics, Harvard University [S]
Eugene J. Rosenbaum, Sun Oil Co. [S]
Bourdon F. Scribner, National Bureau of Standards [E]
S. D. Steele, Babcock and Wilcox, Ltd. (Spectrographic Discussion Group, Glasgow, Scotland) [L]
Mary Warga, The University of Pittsburgh [E]

COMMITTEE WEEK

(Continued from p. 12)

Consistency of Magnesium Oxychloride Cements by Means of the Flow Table; Determination of Linear Change of Magnesium Oxychloride Cements; and Slump Test for Field Consistency of Magnesium Oxychloride Cements.

Efforts will be made to increase the nonproducer membership of the committee to include additional research and university organizations.

Future activity will include the development of specifications now that sufficient test methods have been or are in course of formulation.

Committee C-8 on Refractories

Existing tentatives and standards requiring reapproval were so recommended, covering Classification of Fireclay Refractories (C 27); Method of Tests for Size and Bulk Density of Refractory Brick (C 134); Method of Test for Warpage of Refractory Brick and Tile (C 154), and Specifications for Castable Refractories for Boiler Furnaces and Incinerators (C 213 T). Tentatives revisions covering Methods of Testing Refractory Brick Under Load at High Temperature (C 16); Method of Tests for Cold Crushing Strength and Modulus of Rupture of Refractory Brick and Shapes (C 133), and Definitions of Terms Relating to Refractories (C 71) were recommended for

advancement to standard. There were no recommendations presented covering new proposed standards.

The requirements for modulus of rupture for Type G brick as included in the three specifications covering refractories for heavy duty, and moderate duty stationary boiler service (C 64 and C 153) and for incinerators (C 106) were lowered from 800 to 600 psi.

Interesting progress was reported in the field of two new working groups of the committee covering carbon monoxide disintegration and on carbon refractories.

The next meeting of the committee will be held at the time of the fall meeting of the Refractories Division of the American Ceramic Society.

Committee C-9 on Concrete and Concrete Aggregates

Committee C-9 on Concrete and Concrete Aggregates acted upon several new methods for publication as tentative or as information covering important aspects of the field. A method of test for entrained air of freshly mixed concrete by the pressure method, a method of test for soft particles in coarse aggregate, and a method of test for comparing concretes on the basis of the bond developed with reinforcing steel are being circulated. The test method for evaluating admixtures published as information in the October, 1947, ASTM BULLETIN has been revised in the light of comments received by the committee. The committee has approved by letter-ballot a new Tentative Method of Test for Determination of Bleeding of Concrete as well as revisions in existing standards C 33 (Specifications for Concrete Aggregates), C 131 (Method of Test for Abrasion of Coarse Aggregate by Use of the Los Angeles Machine), and C 192 (Method of Making and Curing Concrete Compression and Flexure Test Specimens).

Recognition has been made of the long and valued services of two of its members, Roy W. Crum and Harry J. Love, by their election to honorary membership in the committee.

A note of deep sorrow and loss was expressed in the announcement of the death on February 25 of Sanford E. Thompson, Honorary Member and first Chairman of Committee C-9.

Committee C-15 on Manufactured Masonry Units

Two new working groups within Committee C-15 reported excellent progress in their respective assignments. Subcommittee IX on Chemical Resistant Units in its first full meeting reviewed and revised a draft form of a tentative specification and expects to recommend its adoption. Subcommittee X on Drain Tile, although new as a group under Committee C-15, has jurisdiction over one of the oldest A.S.T.M. standards, that of Specifications for Drain Tile (C 4 – 24). For the present this standard was recommended for continuance without change but extensive study and review are being being given it with the expectancy that revisions will be proposed.

Revisions in Specifications for Building Brick (C 62) were proposed providing a waiver of durability requirements where no frost action occurs or where less than 20 in. penetration, and substituting a new section on strength requirements using a table of classification. Methods for measuring brick for size and warpage were approved for addition to the Standard Methods of Sampling and Testing Brick (C 67). The physical requirements for NA type sewer brick (C 32) were approved for revision in order to conform with those for MW type of building brick. In addition the requirements for size of sewer brick were revised so that they may be specified by the purchaser, but should fall within one of the standard sizes of building or sewer brick.

All specifications for concrete masonry units (C 90, C 129, C 139, C 145) and for paving brick (C 7) were recommended for continuance without change at this time.

Committee C-16 on Thermal Insulating Materials

The Planning Subcommittee which is the control group of Committee C-16 under the new organization is composed of all officers and subcommittee chairmen. It discussed two important phases of work: One, procedure to be followed in compiling statements on the significance of tests and, two, the need for concentration by all of the subcommittees on only the most essential tests needed in evaluating insulating materials.

New test methods proposed relate to: Water Absorption of Preformed Block Insulation; Density of Preformed Block Insulation and Thermal Conductivity of Materials by Means of the Guarded Hot Box. Other new tentatives reported for action include: Method of Test for Density of Pipe Insulation; Method of Test for Density of Loose Fill Insulation, and Method of Test for Thermal Conductivity of Pipe Insulation Materials. A section covering the significance of the test will now be included in all of the new test methods prepared. Many other test methods are being considered covering such properties as linear expansion, nail holding, plasticity, adhesion, compression, corrosion characteristics, fire resistance, specific heat, and emissivity.

Committee C-17 on Asbestos-Cement Products

Committee C-17 approved its first group of tentatives for letter-ballot. These four specifications cover asbestos-cement roofing and siding shingles, siding clapboards, and flat and corrugated sheets. These specifications include complete test method procedures. The next development will be the completion of a specification covering asbestos-cement pressure pipe; this is now being circulated to the Subcommittee on Methods of Tests for letter-ballot of that portion pertaining to test procedures.

Committee C-19 on Structural Sandwich Constructions

Engineers have long been familiar with the advantages of certain composite types of construction when two or more dissimilar materials are used together in such a manner that each supplements the other bringing out the best features of each. One of the more recently developed ideas in the field is the structural sandwich panel in which alternating layers of dissimilar material are cemented or bonded together to provide a strong, lightweight assembly peculiarly well stuited to some structural purpose. An early example is found in the Mosquito Bomber in which extensive use was made of panels of plywood bonded to each side of a balsa wood core to give a panel that was much stiffer and stronger than the same weight of plywood alone. Other examples are found in ship bulkheads and in the building industry, particularly in prefabricated housing.

The increasing interest in structural sandwich construction has led the A.S.T.M to form Committee C-19 to deal with the subject. Subcommittees are at work on four phases of the work: Mechanical Properties of Basic Materials; Mechanical Properties of Basic Sandwich Construction; Permanence, Durability, and Simulated Service; and Nomenclature and Definitions.

A number of sections of the subcommittees made preliminary reports at these meetings and it is hoped that work can be started toward testing programs and tenatative standards in the near future.

The Subcommittee on Mechanical Properties of Basic Materials has been further subdivided into sections on Mechanical Properties with S. E. Mautner as Chairman; Physical Properties, W. D. Eisenhauer, Chairman; and Electrical Properties, C. B. Hemming, Chairman. The Subcommittee on Mechanical Properties of Basic Sandwich Construction will divide its work into Sections on Bond Strength, R. C. Platow, Chairman; Compression, J. A. Roy, Chairman; Flexure, G. R. Hiusman, Chairman; Shear, A. G. H. Dietz, Chairman; and Tension, T. P. Pajak, Chairman. The Subcommittee on Permanence, Durability, and Simulated Service will function with sections on Exposure Facilities, R. A. Biggs, Chairman; Aircraft, S. A. Gordon, Chairman; Packaging, K. W. Kruger, Chairman; Miscellaneous, R. C. Platow, Chairman; Furniture, L. Repsher, Chairman; Building Construction, E. C. Shuman, Chairman; and Transportation, J. H. Tigelaar, Chairman.

Committee D-1 on Paint, Varnish, Lacquer, and Related Products

Important progress was made on many

of the standardization and research activities of Committee D-1 at its numerous sessions during A.S.T.M. Committee Week. One of the important new projects involves printing inks, where the committee has agreed to undertake the development of test methods for evaluating various properties of these materials.

At the conclusion of the meeting of the main committee, there was held a Panel Discussion on "Practical Aspects of the Testing of Paint and Varnish Products." The moderator was Mr. Francis Scofield of the National Paint, Varnish & Lacquer Assn., Inc. The questions were answered by four panel members, Mr. W. Grier Armstrong, du Pont de Nemours & Co., Inc., Mr. Sophus Bolme, Ronsted-Mason Co., Mr. Robert R. Bruhr, Sherwin-Williams Co., and Mr. Charles E. Hartman, National Bureau of Standards. The many interesting questions showed a real interest in the subject.

A new Subcommittee on Printing Ink is being organized under the sponsorship of Committee D-1. Work on this subject is being undertaken due to numerous requests concerning specifications and test methods of printing inks and products used therein. A preliminary survey indicates immediate need for a program covering development of test methods including procedures for such determinations as: Fineness of grind, Drying time of various types of inks, Rubproofness, Greasing tendency of lithographic inks, Tack, Consistency, Fading, Livering, Ink mileage, and Printing Quality. It is planned to organize this subcommittee in the near future at a conference of manufacturers, users, and others interested in printing inks. Anyone interested in this project is invited to write to A.S.T.M. Headquarters.

The Subcommittee II on Drying Oils presented a method of test for acetone number. A method of test for hydroxyl number has also been developed and cooperative test work is under way. Tests for determining set-to-touch time for drying oils are being studied. The hydrochloric acid break test has been completed. Work is in progress on diene value. Revisions were presented in the foots test and in the Specifications for Oiticica Oil (D 601).

The subcommittee on volatile solvents for organic protective coatings reported that work is being conducted on a nihiline point and kauri-butanol tests and the possible connection between these tests, on nitrocellulose diluting power, naphtha toluene and heptane number, and viscosity reduction. This work has involved some eighty cooperative samples. In the work, the subcommittee has had the cooperation of the Philadelphia Paint and Varnish Production Club, and of two other subcommittees. Consideration is also being given to simplicity of tests and apparatus for the consumer interests and application requirements, such as precipitation limits and viscosity reduction. Work is also being done on methods of test for volatility.

The subcommittee on definitions has prepared definitions for "sealer," "size," and "spar varnish."

The Tentative Method of Preparation of Steel Panels for Testing Paint, Varnish, and Lacquer and Related Products (D 609–46 T) is to be revised. The changes add provisions for packaging standard A.S.T.M. steel panels and include three procedures for cleaning or treating the surfaces: namely, Procedure A for testing on steel without chemical treatment, Procedure B for testing on chemically cleaned steel, and Procedure C for testing on chemically treated steel.

Work is continuing on humidity and immersion testing. Additional cooperative testing projects are being planned. A paper covering the 1946–1947 project on "Effect of Temperature on the Rate of Blister Failure of Finishes on Steel in Water" by J. A. Boylan and R. I. Wray appears elsewhere in this BULLETIN.

The subcommittee on chemical analysis presented a report covering revisions of Methods for Analysis of Chrome Pigments (D 126–36), White Pigments (D 34–47), Zinc Dust (D 521–40), and Iron Oxide Pigments (D 50–36). Work is under way on a standard method of analysis of inorganic blue pigments. In developing new methods, the subcommittee arranges for the procedures to be checked in several laboratories prior to recommending them for publication.

The subcommittee on varnish recommended that the Tentative Method of Test for Phthalic Anhydride Content of Alkyd Resins and Alkyd Resin Solutions (D 563–47 T) be adopted as standard. This subcommittee has under active discussion and cooperative testing the methods for dust-free, tack-free, and print-free times of varnish. Further cooperative testing on the cotton fiber method for dust-free time and on the Zapon tack tester is planned. Other studies include a test for miscibility of raw linseed oil with lead driers, and the effect of variations in oil quality upon this test.

Work is also in progress on a method of test for determining the nonvolatile content of varnishes. Cooperative tests are being conducted in connection with a proposed revision of the Kauri reduction test. Methods to measure the color of dried transparent films are being investigated.

The determination of viscosity is being studied through three types of viscometers: the efflux cup, the bubble tube, and the rotational type. First consideration has been given to efflux cups which are of use on nontransparent varnishes and related Newtonian liquids. Early cooperative testing of a selection from about 40 cups used in the industry showed wide variations in reproducibility. Further cooperative tests on the Ford, Saybolt, and A.S.T.M. cups have been completed.

Work is in progress on reactivity of paint liquids, exterior exposure testing of varnishes, wear resistance testing, and the analysis of phthalic anhydride.

The subcommittee on optical properties presented an extensive revision of the Tentative Method of Test for Specular Gloss of Paint Finishes (D 523–48 T). Proposed definitions of the terms "luminous directional reflectance" and "gloss" have been prepared. Work is in progress on goniophotometry, small color differences, hiding power, and night visibility of traffic paints.

The subcommittee on resins is working on the determination of nitrogen in nitrogenous resins, color, viscosity, and specific gravity of alkyd resin varnishes, and the applicability of the specific gravity method (D 555–47) to nitrogenous resins. Round-robin tests have been made on nonvolatile determinations. This subcommittee is working on acid and iodine number of alkyd resins, softening points, viscosity, solubility, specific gravity, and color determinations on resins. The solvent tolerance of resin solutions is being studied in cooperation with the subcommittee on volatile solvents. Methods to determine the free phenol in phenolic resins and chlorine in vinyls are being developed.

It is planned to carry out work on haze and clarity of resin solutions, classification of phenolic resins with respect to behavior under heat, a scheme for identification of base phenols, solvent tolerance of amine resins, a scheme for elemental analysis for nitrogen, sulfur, halogens, and phosphorus in resins.

The subcommittee on shellac recommended revisions of the Standard Specifications for Dry Bleached Shellac (D 207–35) which deletes the maximum iodine number requirement, inserts new requirements for rosin and copals, and changes the moisture requirement from "5.0" to read "6.0" per cent max.

The subcommittee on pigments recommended a revision of the Standard Specifications for Zinc Yellow (Zinc Chromate) (D 478–47), which deletes the requirements for "combined water." It also has prepared a new specification for calcium carbonate and revisions in the specifications for Aluminum Pigments (D 266) and Magnesium Silicate Pigment (D 605).

Also in preparation are new specifications for para red toner dark which is in addition to the present Tentative Specifications for Para Red Toner Lights (D 475).

Work is to be undertaken on revision of the Specification for Pure Linseed Oil Putty (D 317) based on the specifications for calcium carbonate which is used in the production of putty.

The subcommittee on physical properties has completed a new tentative method for the measurement of dry film thickness of paint, varnish and lacquer products. Work is being done on measurement of thickness of thin films, preparation of uniform films, measurement of paste consistency, measurement of chalk resistance of pigments, measurement of hardness of paint films, oil absorption of pigments, adhesion of paint films, and specific gravity of pigment.

The subcommittee on cellulose and related products has revised the Standard Specifications for Tricresyl Phosphate (D 363–46) by deletion of the requirement

for "free phenols" and a change in the acidity requirement from "0.005" to "0.01" per cent.

A revision of the Tentative Method of Test for Ester Value of Tricresyl Phosphate (D 268–46 T) consists of changing in Section 5, paragraph (*a*) "3 g." to "6 g." and in Paragraph (*b*) the words, "30 min. on a hot plate at 200 C." to "2 hr. at 200 C. or until all oil disappears."

An editorial revision in the numerous specifications for paint and lacquer solvents consists in describing the 10 degree heptane (having an aromatic content of not over 5 per cent) used in the water miscibility test.

New specifications for Secondary Butyl Alcohol were presented as tentative.

The draft of new tentative methods covering procedures for determining the resistance to cracking or checking of clear nitrocellulose wood lacquers when subjected to sudden transition from warm to cold temperatures was discussed and changes incorporated. The subcommittee also considered the results of a questionnaire dealing with some 30 present and proposed test methods for finished lacquers. Replies were received from 20 of the 22 committee members. There was a general consensus on a number of the individual test procedures and very enlightening and helpful comments on others. The information obtained will serve as a basis for revision and enlargement of the present Standard Methods of Testing Nitrocellulose Clear Lacquers and Lacquer Enamels (D 333–40).

The subcommittee on painting structural iron and steel presented a new procedure for the atmospheric testing of paint coatings on steel.

This subcommittee has decided to terminate the current exposure testing program with a report on "Surface Preparation and Repainting of Structural Iron and Steel," by A. J. Eickhoff, to be published as an appendix to the 1949 Report of Committee D-1.

Committee D-2 on Petroleum Products and Lubricants

(Washington, D. C., February 14 to 18)

COMMITTEE D-2 on Petroleum Products and Lubricants held its Spring Meeting in Washington, at the Shoreham Hotel, February 14 to 18, with an attendance of over 200. There were 58 technical meetings. The meeting was highlighted by a Symposium on Lubrication of High-Speed Gears sponsored by Technical Committee C on Turbine Oils. The four papers comprising this were:

- Lubrication of Naval Gearing, by Commander R. T. Simpson, U.S.N.
- Developments in Gear Design and Their Lubrication Requirements, by Larry Collins, Engineer of the Gear Division, General Electric Co.
- Physical Concepts of the Establishment of the Lubricating Oil Wedge and Its Associated Load-Carrying Capacity for Films Separating the Mating Tooth Surfaces of High-Speed Gears, by E. K. Gatcombe, Assoc. Prof. of Mechanical Engineering, U.S.N. Post Graduate School, Annapolis, Md.
- Lubrication of Worm Gears, by A. R. Purdy, Staff Engineer, Industrial Division, Socony Vacuum Oil Co.

Committee D-2 has decided to participate in the A.S.T.M. national meetings to be held in San Francisco, Calif., during the week of October 10 and a number of the technical committees and divisions will hold meetings at that time. Technical Committee C on Turbine Oils is planning to sponsor a Symposium on Turbine Oils which will include papers covering problems encountered in the lubrication of industrial turbines, lubrication and cleaning practices of marine turbines, problems and requirements of gas turbines, and operating experiences and special problems in electrical utility installations.

The new Research Division on Elemental Analysis will also sponsor a Symposium on Polarographic Methods for Metals in Lubricants at the San Francisco meeting. The committee is also cooperating in arrangements for a Symposium on Super Duty Oils for the San Francisco meeting. This symposium will deal largely with the high additive content oils.

Technical Committee A on Gasoline has under review the present geographical and seasonal zoning information in the Specifications for Gasoline (D 439–48 T) to determine whether it is still satisfactory. In this connection it is planned to obtain detailed climatological data, in cooperation with the Weather Bureau. This will aid in determining the significance of altitude on vapor lock of motor vehicles.

This technical committee made plans to sponsor a Symposium on Recent developments for the Determination of Tetraethyl Lead in Gasoline. It also took action to adopt as standard the Tentative Method of Test for Oxidation Stability of Aviation Gasoline (Potential Gum Method) (D 873–46 T) with a revision in the procedure for measuring visible lead precipitate. Some changes were also made in the Methods of Test for Existent Gum in Gasoline (Air-Jet Evaporation Method) (D 381–46) and for Oxidation Stability of Gasoline (Induction Period Method) (D 525–46).

Technical Committee B on Lubricating Oils announced that it was making arrangements for a committee Symposium on Valve Burning which would deal with both intake and exhaust valves. This timely symposium will comprise five papers. It is scheduled to be held on June 28 in connection with the next meeting of Committee D-2 at Atlantic City, N. J. Other subjects being studied include classification of crankcase oils, foaming and channel test of gear oils, study of behavior of instrument oils in service, including oxidation stability, and test for air compressor oils. Further consideration is being given to the foaming test, and revision of the Standard Method of Test for Dilution of Crankcase Oils (D 322–35) will be undertaken.

At the request of *Technical Committee C*, its scope is being extended to cover the lubrication of non-aircraft gas turbines. It is believed that this equipment will have similar lubrication problems and will accordingly require the same oils as do steam turbine equipment. Revisions were made in the Tentative Method of Test for Rust-Preventing Characteristics of Steam-Turbine Oil in the Presence of Water (D 665–47 T).

Technical Committee F has announced plans for a Symposium on Effect of Diesel Fuels on Engine Deposits.

Technical Committee G on Lubricating Grease recommended the publication as tentative of the Proposed Method of Test for Micro Penetration of Lubricating Grease. A Method for Determining the Apparent Viscosity of Lubricating Greases will be published as information. Work is to be undertaken by a new Section on Corrosivity of Greases. Study is being made of the Methods for EP Lubricants for possible application to greases.

Technical Committee H on Light Hydrocarbons submitted a revision for immediate adoption of the Test for Vapor Pressure of Petroleum Products (Reid Method) (D 323–43). The revision comprises a number of editorial improvements and the inclusion of information regarding precautions to be taken in making the test. Four new methods for testing butadiene were recommended for publication this year covering procedures for determining acetylene content of C_4 mixtures, oxygen content of butadiene vapors, boiling point range and peroxides in butadiene. It also recommended the publication as tentative of three methods issued last year as information. These cover tests for separation of residue from butadiene, butadiene dimer in polymerization grade butadiene, and nonvolatile residue of polymerization grade butadiene.

Technical Committee J on Aviation Fuels is studying improvements in several of the tests used in connection with the Tentative Specifications for Aviation Gasolines (D 910–48 T).

Technical Committee K on Cutting Fluids has been furthering its program for the laboratory evaluation of cutting fluids and also apparatus and procedure for plant evaluation of cutting fluids. A set of proposed definitions on functions, type, and designations of cutting fluids has been prepared.

The Division on Combustion Characteristics and seven of its sections held meetings. Arrangements were made to further the test program on establishing the reproducibility of the F 21 procedure for rating aviation fuels. A group is studying the improvement in precision of testing fuels for anti-knock quality, particularly with regard to barometric pressure. The division recommended publication of a report on the iced carburetor with the 1949 Report of Committee D-2. Action was taken on revision in the tolerance on density and refractive index of ASTM knock-test reference fuels from the present value of "±0.00010" to "± 0.00015." This division and its sections will meet in June and also in San Francisco in October.

The Division on Corrosion Tests reported completion of a Proposed Tentative Method for Copper Strip Corrosion Tests which will incorporate the several procedures now described in other A.S.T.M. standards. This new method will described the polishing technique in detail.

The Subcommittee on Paraffin Waxes submitted a revision of the Test for melting Point of Petrolatum (D 127–30) to include a procedure for high melting point microcrystalline waxes. This new procedure requires the use of a new thermometer having a range of 90 to 260 F. A new proposed semi-micro method of test for oil content of petroleum waxes was submitted for publication as tentative to replace Method D 721.

Subcommittee V on Viscosity reported that studies are under way for determining viscosity at high rates of shear. These include the taper plug viscosimeter and the multiple calorimeter viscosimeter. It is hoped that rates of shear up to 1,000,000 reciprocal seconds will be obtained. An important revision in the Tentative Method of Test for Kinematic Viscosity (D 445–46 T) includes changes in Table II regarding calibration of the kinematic viscosimeters and the publication with the method of some supplementary information regarding apparatus.

Subcommittee VIII on Distillation has under way a very extensive study of a proposed method for vacuum distillation. Duplicate distillation for standard stocks are being made by a number of cooperating laboratories. Many of the test details and apparatus for the test are being closely studied. Reaffirmation of the Standard Method of Test for Distillation of Gasoline, Naphtha, Kerosene, and Similar Petroleum Products (D 86–46) was recommended.

Subcommittee VII on Sulfur Determination and *Subcommittee XI on Determination of Inorganic Elements in Lubricants* have been cooperating very closely. A test program to be carried out during the coming year will include study of the quartz tube, vertical tube, and bomb methods for determining sulfur. The proposed test for sulfur in petroleum products by the CO_2-O_2 lamp method published as information in 1947 was recommended for republication as information in 1949. A new method for determination of phosphorus was recommended for publication as information. A single procedure for determining sulfur based on the present Methods of Test for Sulfur in Petroleum Oils by Bomb Method (D 129–44) and for Sulfur in Lubricating Oils Containing Additives and in Additive Concentrates by Bomb Method (D 894–48 T) was recommended for immediate publication as standard.

The Subcommittee on Neutralization Number and Saponification recommended the adoption as standard of the Test for Neutralization Value (Acid and Base Numbers) by Electrometric Titration (D 664–46 T).

Subcommittee XV on Measurement and Sampling and its sections on Gaging Procedure, Temperature Measurement, and Units of Measurement, Calculations and Tables held meetings. Work was completed on the new methods of gaging petroleum and petroleum products, and final changes were made in the method of measuring temperature. The methods of sampling have been reviewed. All three of these methods should be ready for publication in a manual on sampling and gaging to be issued later this year. Plans were furthered on the oil measurement tables being developed in cooperation with the British Institute of Petroleum. It is hoped that the actual calculation work may be initiated late in the spring.

Subcommittee XX on Nomenclature reported revisions for immediate adoption in the Standard Definitions of Terms Relating to Petroleum (D 288–48). These revisions covered the terms Benzin, Petroleum Ether, Legroine, and Naphthenic Acids.

Subcommittee XXV recommended the adoption as standard of the Method for Measurement of Density of Hydrocarbon Liquids by the Pycnometer (D 941–47 T). This subcommittee is very active on a number of projects and several should be completed by the June meeting, including the method for analysis of jet fuels. The test for total olefinic and aromatic hydrocarbons in petroleum distillates published in 1947 is being revised. A short-cut method for analysis of Diesel fuels is being studied in cooperative tests. Extensive data on the lamp method for determination of hydrogen have been obtained and this method will be published as tentative this year.

Committee D-4 on Road and Paving Materials

Three new methods of test were reported in final stages of development. A proposed method for compression testing of compacted hot-mix, hot-laid bituminous mixtures; a method of testing fine aggregate bituminous mixtures based on the Hubbard-Field stability test; and an immersion-compression test for compressed bituminous mixtures, will be recommended for acceptance in all probability by the next meeting.

A complete review of the numerous standards and tenatatives under the jurisdiction of D-4 has resulted in recommendations for revisions and advancement to standard of many of these and others too numerous to describe in this issue. Those changes deserving special mention are the modifications of standards covering aggregate gradings and sizes for highway construction (D 448, D 692, D 693, D 694) to conform with the latest Simplified Practice Standards of the National Bureau of Standards.

The Symposium on Accelerated Durability Tests of Bituminous Mixtures promises to be a very comprehensive and valuable coverage of this important work. Fourteen papers by leading men in this field will occupy two sessions at the A.S.T.M. Annual Meeting in June. This is sponsored jointly by Committees D-4 and by D-8 on Bituminous Waterproofing and Roofing Materials.

Committee D-5 on Coal and Coke

Subcommittee I on Methods of Testing reported a very active discussion on Ultimate Analysis. A large amount of data on ultimate methods now in use had been collected and formed the basis of a tentative method for determinations of carbon and hydrogen which was discussed in detail. From resulting suggestions a revision is to be prepared and circulated for consideration at a meeting which it is hoped can be held in connection with the Pittsburgh meeting of the A.C.S. Fuels Division in May. A similar treatment of the nitrogen determination had to be deferred to the latter meeting because of lack of time.

Subcommittee XV on Plasticity and Swelling reported results of a very interesting cooperative test of standard samples of two widely different grades of pitch in the Geiseler Plastometer by twelve laboratories now using this instrument. In consideration of variations shown, the committee has outlined steps further to standardize instrument design and the chairman will circulate new samples for a further check on reproducibility. Considerable discussion was held of slot-type test ovens now in use for expansion and quality testing of coking coals and it is indicated that current research sponsored by the American Gas Association is likely to be of great help toward eventual standardization of this type of test. Overlapping membership should insure liaison in following this work.

The Free Swelling Index has assumed increased importance of late, and the Subcommittee voted to recommend two alterations for the consideration of Subcommittee I: first, that the term "zero button" be used to designate coals which do not form a coherent mass at all, and, second, that the use of some suitable profile area measuring method replace the present standard requirement wherein an operator's judgment matches buttons with standard profiles. The present standard profiles would form the basis of an area scale so that former results would be entirely comparable with new work. This suggestion is based on a recent contribution of the U. S. Bureau of Mines Laboratories.

Subcommittee XVI on Ignitability of Coal and Coke met after a considerable period of inactivity and the chairman reports a gratifying interest in this work. A drawback has always been the difficulty of correlating present test methods for reactivity with the behavior of coal in regular combustion equipment, for example, furnaces and stokers. However, good correlation has been reported between the test and heating of coal on storage. The committee will attempt the preparation of a formal method which can be published as information since it is felt that a more rapid accumulation of data regarding correlation would result.

The general plan of the work of Sub-

committee XVII on the Significance of Tests on Coal and Coke entails considerable subdivision of effort and it was indicated that many of the groups have been actively collecting the needed material.

Subcommittee XX on Sampling and Fineness Test of Pulverized Coal announced plans to enlarge the committee by the addition of members representing several of the utilities because of the latter's interest in and facilities for cooperative work of this nature. The program of cooperative testing was extended, and in addition it was indicated that at least one large equipment manufacturer has current work on this subject under way which can be released to the committee probably before the end of the current year and which promises answers to many of the questions involved.

Committee D-11 on Rubber and Rubber-Like Materials

Committee D-11 on Rubber and Rubber-Like Materials held one of its best meetings of recent years, March 1 to 4. In addition to the main committee, 18 subcommittees and the Joint SAE-ASTM Technical Committee on Automotive Rubber met.

One of the highlights of the meeting was the Symposium on Aging of Rubbers consisting of six papers held on March 2 under the sponsorship of Committee D-11.

The committee has been cooperating with the Federal Specifications Board in a review of an extensive revision of the Federal Specification for Rubber-Goods; General Specifications (Methods of Physical Tests and Chemical Analyses) (ZZ-R-601). The various test procedures to be included in this revised federal specification have been studied and commented on by members of the committee.

A report on the meeting in London, England, on June 28 and 29, 1948, of Technical Committee 45 on Rubber, of the International Organization for Standardization was presented by the A.S.T.M. representative, H. G. Bimmerman. It was reported that ISO Committee 45 will hold its next meeting in Holland in about the middle of 1949, and Committee D-11 at its meeting took action to extend an invitation to the ISO Technical Committee 45 on Rubber to hold its 1950 meeting in the United States. It was proposed that if this invitation should be accepted arrangements would be made to hold the meeting in connection with the 1950 A.S.T.M. Annual Meeting scheduled for Atlantic City, N. J.

A report was presented by the Special Committee on Standard Reference Samples. As a result of round-robin tests in five cooperating laboratories on some 15 compound formulas, it was found possible to reduce the number of compounds to 13. It was also announced that the National Bureau of Standards now has for sale the following seven compounding ingredients: zinc oxide, sulfur, stearic acid, benzothiazyl disulfide, tetramethylthiuram disulfide, channel black, and light magnesia.

Action was taken by Committee D-11 to request that Committee E-1 on Methods of Testing establish a subcommittee to consider the subject of low-temperature testing of elastomeric materials. This group would include representatives from various A.S.T.M. technical committees interested in these tests and also members from industry and Government agencies.

The SAE-ASTM Technical Committee on Automotive Rubber has been very active and its meeting was one of four held during the past year. It has under way an extensive program on vibration insulators to determine the following characteristics of rubber as applied to automotive engine mounts: (a) resilience or efficiency, (b) dynamic modulus or spring rate, and (c) static modulus or load-carrying properties.

Specifications have been completed for automotive mats and for windshield wiper tubing and for rubber automotive heater hose. New specifications are in preparation for hydraulic window lift hose. One very important project being developed is the standardization of vendor identification for rubber products. The proposed keys for source identification letters for manufacturers of molded products and for manufacturers of extruded products are now the subject of letter-ballot in the joint technical committee. Similar codes for identification of die-cut products and special products are now under development. A set of methods for testing V-belts is in preparation and general specifications for gaskets for automotive uses will be completed in time for the June meeting. New specifications for hydraulic brake cups for heavy-duty service have been completed.

It was announced that a new Subcommittee on Statistical Quality Control as applicable to the rubber industry would be appointed in the near future. The committee also decided to appoint an editorial subcommittee to keep up to date a bibliography on rubber and also to review the various methods as completed by the committee.

The Subcommittee on Hose recommended the immediate revision of the Standard Specifications for Cotton Rubber-Lined Fire Hose for Public and Private Fire Department Use (D 296–38). These specifications are also the American Standard L 3.1-1941 approved by the American Standards Association. The revisions will bring the specifications into agreement with the current standard of the Underwriters' Laboratories. Revisions were also reported in the Tentative Methods of Testing Rubber Hose (D 380–46 T). The changes will permit the use of a steel caliper graduated in $\frac{1}{64}$ in. for measuring the outside diameter of hose 1 in. or less in diameter. The maximum limit of 3 ft. will be added to the length of the test specimen used in the burst test. The immersion test for swell and deterioration of hose will also be broadened to cover the use of immersion fuels 1 and 2 and the test procedure now specified in Method D 471.

The Subcommittee on Thread Rubber reported completion of round-robin tests on extruded and cut rubber thread to check the reproducibility of various industry methods. As the result of the data obtained in these studies, it was agreed to write up methods covering tests for size, yards per pound, modulus and permanent set, and tension and recovery.

The Subcommittee on Insulated Wire and Cable submitted an important revision in the Tentative Methods of Testing Rubber Insulated Wire and Cable (D 470–48 T) to include three new methods for determining water absorption. These alternate methods are based on those of the Insulated Power Cable Engineers Association. A revision of the Tentative Specifications for Rubber Sheath Compound for Electrical Insulated Cords and Cables (D 532–46 T) will remove the tear test and place it in the general Methods D 470. The two specifications for GR-M polychloroprene sheath compound for electrical cords and cables are being revised to include the use of No. 2 oil. Another revision of Method D 470 is the inclusion of an electrometric method for ozone concentration as an alternate to the present chemical test specified. This subcommittee is investigating specifications for polyethylene and silicone rubbers, and specifications for thermoplastic vinyl polymer sheaths for electrical insulated cords and cables are to be published as tentative in June.

At the meeting of the Subcommittee on Packing, a paper on creep and relaxation of compressed asbestos gaskets was read by F. C. Thorn. This subcommittee reports that corrosion studies of compressed asbestos sheet showed practically no corrosion, and it was decided to undertake a more severe test. This subcommittee has under study the use for general applications of the specifications for compressed asbestos gaskets prepared by the Joint SAE-ASTM Committee. The Navy seal aging test used by the Navy for sealing of portholes and similar applications is being studied.

The Subcommittee on Rubber Latices presented for publication as information proposed Specifications and Methods of Test for Concentrated, Ammonia Preserved, Creamed and Centrifuged Natural Rubber Latex. These specifications cover requirements for first-grade concentrated natural rubber latex of the following types:

Type I.—Centrifuged natural latex preserved with ammonia only or by formaldehyde followed by ammonia.

Type II.—Creamed natural latex preserved with ammonia only or by formaldehyde followed by ammonia.

Included are detailed provisions for sampling and testing both types of latex. These proposals are quite timely in view of the large number of new producers, particularly natives in the Far East who have entered into the production of rubber latex since the end of the war. The proposed specifications will be published in the form of proposed recommendations and will be submitted through the Rubber Manufacturers' Association to other in-

terested organizations in this country and throughout the world.

The Subcommittee on Physical Tests reported completion of an extensive revision of the Tentative Methods of Tension Testing of Vulcanized Rubber (D 412-41). It also has under way a revision of the Standard Methods of Sample Preparation for Physical Testing of Rubber Products (D 15-41). A study of the coefficient of friction test is to be undertaken.

The Subcommittee on Chemical Analysis reported plans for revision of the Tentative Methods of Chemical Analysis of Rubber Products (D 297-43 T) to bring them into substantial agreement with the revised federal specifications. It also reported that plans had been made for active improvements in methods of analysis for sulfur, carbon black, synthetic rubber, and a solvent method for rubber hydrocarbon determination.

The Subcommittee on Abrasion recommended that the Graves test specimen designated as Die C in the revised Method D 624-48 be used in preference to Die A or B wherever possible. It was reported that the Schiefer abrasion method appears to have promise for testing processed fabrics. The joint SAE-ASTM Committee has under way a study of the difference in temperature of tires operating under different ambient conditions in order to determine the effect of temperature on abrasion.

The Subcommittee on Life Tests reported plans for undertaking a program in cooperation with Committee D-20 for evaluating the aging of plastics. Work is under way in 16 cooperating laboratories on ozone aging. Revisions for immediate adoption were presented in the Air Pressure Heat Test (D 454), the Oxygen Pressure Method (D 572), and the Test Tube Method (D 865) as regards the heating media and methods for measuring the temperature thereof.

The Section on Hardness and Creep Test presented revisions in Method D 676 covering the calibration of durometers. This applies to both the Shore and Rex durometers. A test for low-temperature set is expected to be completed by the June meeting.

The Subcommittee on Flexing Test presented for publication as tentative a new method of test for resistance of vulcanized rubber or synthetic elastomers to cut growth by the use of the Ross Flexing Machine. This method is intended for use in determining the resistance of vulcanized compounds of crude rubber or synthetic elastomers, or blends thereof, to cut growth when subjected to repeated bend flexing. The Standard Methods of Dynamic Testing for Ply Separation and Cracking of Rubber Products (D 430-40) are to be revised. This standard now covers three separate procedures using the Scott, de Mattia, and the du Pont Flexing Machines. The revision will separate these into three individual methods with appropriate cross references. A special committee was appointed to undertake a revision of Method A using the Goodrich Flexometer in the Tentative Method D 623.

Arrangements have been made by the Subcommittee on Immersion Test for a supply of reference oil No. 2 meeting the requirements prescribed in Method D 471. The alternate gasoline type test liquids being recommended by the Government are to be studied by this subcommittee.

The Subcommittee on Liquid Rubber Products is considering developing test methods for a relatively new type of synthetic rubber-resin adhesive.

The Subcommittee on Cellular Rubbers presented as tentative new specifications and methods of testing latex foam rubbers and separate specifications and test methods for sponge and extruded cellular rubber products. These two new tentatives will be a revision and consolidation of the present Tentative Specifications D 798 and Methods D 552. The revision includes both specifications and test methods for the particular type of cellular rubber.

Plans were reported for revision of the Methods of Testing Hard Rubber Products (D 530-48 T). Compounds to be used in cooperative round-robin tests have been agreed upon. A special meeting is to be held at an early date to complete plans for this work. The Tentative Methods of Testing Asphalt Composition Battery Containers (D 639-46 T) are also under revision. Need was expressed for an impact strength test for these materials; also a revision of the bulge test is to be undertaken.

The abrasion testing program on coated fabrics includes studies of the Schiefer abrasion machine. Round-robin tests are also under way on the edgewear testing machine of the American Seating Co. The Stoll abrader and the Taber Abrader are also being studied.

The Subcommittee on Low Temperature Test recommended the withdrawal of the Tentative Method of Test for Low-Temperature Brittleness of Rubber and Rubber-Like Materials (D 736-46 T). With the discontinuation of this method, the committee recommended use of the Tentative Method of Test for Brittle Temperature of Plastics and Elastomers (D 746-44 T). It also recommended as tentative the Method of Measuring Low-Temperature Stiffening of Rubber and Rubber-Like Materials by the Gehman Torsional Apparatus which was published as information last year.

The Subcommittee on Resilience Test recommended for publication as tentative the Method of Test for Impact Resilience and Penetration of Rubber by the Rebound Pendulum recently published as information. The future work of this subcommittee will deal with forced vibration test.

Committee D-15 on Engine Antifreezes

(Washington, D. C., February 21 and 22)

THERE was an attendance of approximately 50 members and guests at the series of meetings of Committee D-15 and its subcommittees held at the Shoreham Hotel, in Washington, on February 21 and 22.

One of the features of the meeting was an organization session of the new Subcommittee VII on Specifications. This subcommittee discussed a detailed list of properties important in the development of purchase specifications which revealed that further information was needed with respect to a number of them. One of these is storage stability. The matter of sampling is also most important and it was decided to establish a study group on this subject.

The Subcommittee on Freezing Point Determination reviewed in detail a draft of a proposed method. The committee was presented with three additional methods which will be studied and a further draft method prepared for action at the next meeting. Some cooperative test data obtained will be compiled for publication.

The Subcommittee on Antifreeze Field Testers has completed proposed specifications for a hydrometer-thermometer antifreeze field tester.

A Subcommittee on Physical Properties reviewed a proposed method of test for specific gravity of engine antifreezes by means of the hydrometer. This method is intended for antifreezes in the original concentrated condition. After some further cooperative study it is expected that the method will be ready for publication. This subcommittee was also requested to develop a method of test for specific gravity of aqueous antifreeze solutions. In this connection the Subcommittee on Antifreeze Field Testers agreed to develop companion specifications for a specific gravity tester. This subcommittee also has under study the question of heat transfer.

Subcommittee IV on Chemical Properties has developed tests for reserve aklalinity and procedures for determining pH. These will be studied by cooperative laboratory tests using 33 per cent and 50 per cent solutions. This committee has under way a cooperative test program in four laboratories on a study of the Karl Fischer method for water content. Studies are being made on determination of ash and solids content.

The Subcommittee on Simulated and Actual Service Testing reviewed in detail a circulating corrosion test for engine antifreezes intended for evaluating inhibitor effectiveness of antifreeze solutions in the laboratory under conditions simulating service operation. The method will be subjected to a cooperative test program in several laboratories. The study group also reported plans for a more extensive test program to study this corrosion test.

Attention was called to the National Bureau of Standards Folder 474 on Automotive Antifreezes, by D. B. Brooks and R. E. Streets. This bulletin contains complete information on antifreeze, what strength should be used, and what kind of antifreeze is best suited to the service involved. Pertinent physical properties and service performance of the major cate-

gories of antifreezes are given. A section treats how the automobile should be prepared for antifreeze. Simple means for distinguishing the different types of antifreezes and for determining the protection are described. The replacement of antifreeze solution loss and the question of whether antifreeze solutions can be used safely for more than one season is discussed. Copies of the circular are obtainable from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 15 cents each.

Committee D-19 on Industrial Waters

The Editorial Subcommittee of Committee D-19 reviewed further and made substantial progress on the Manual on Industrial Water which is in preparation.

The Subcommittee on Methods of Sampling voted to recommend as a tentative the Method of Steam Sampling heretofore published as information only. During the past year a number of constructive comments had been received and these were incorporated in the method. The subcommittee also recommended to advance to standard the Method of Sampling Water for Industrial Uses (D 510) with some revisions, and the Recommended Practice for Field Sampling of Water-Formed Deposits (D 887). The Method for Sampling Boiler Water from Stationary Boilers (D 860) will be continued as tentative since it is under revision looking toward future revision.

The Subcommittee on Methods of Analysis is proposing the adoption as standard of the Methods for Determination of Chloride Ion (D 512) and of Sulfate Ion (D 516) with revisions. The same action is recommended for the Method of Test for Manganese in Industrial Water (D 858) without change. The Method of Determination of Dissolved Solids, previously published as information, is being presented as a tentative as are two new methods—one for acidity and alkalinity and the other for iron in industrial water. The Method of Test for Dissolved Oxygen (D 888) was revised and is being retained as tentative. A new nonreferee method for determination of total carbon dioxide is being added to the present method (D 513) and the subcommittee is working on drafts of new methods for specific electrical conductance and hardness of water.

The Subcommittee on Classification is studying a proposed specification for reagent grade water, while the Subcommittee on Methods of Testing is recommending advancement to standard of the Methods of Field Test for Embrittlement (D 807) and the NDHA Corrosion Test (D 935). Two new subsections have been constituted to work on the problems of a substitute ocean water, and service tests for metallic pipe and tubing.

One of the newer activities of the Committee centers in the work of the Subcommittee on Water-Borne Industrial Wastes. This subcommittee, with L. Drew Betz serving as Chairman, was organized at a meeting in Pittsburgh on October 19, 1948. At the meeting, with an attendance of over ninety per cent of the members as evidence of interest in this important subject, the organization, scope, and programs of the working sections of the subcommittee were completed.

S. A. Braley will be Chairman and M. U. Priester will be Secretary of the section on Critical Constituents. Other sections and the corresponding officers who will direct their activities are: Analytical Methods, R. F. Weston and R. W. Haywood; Sampling, Gaging and Preservation of Samples, C. P. Hauck and L. C. Flickinger; and Methods of Reporting of Analytical Results, W. W. Hodge and W. K. Aites.

The committee also completed plans for a water session it is sponsoring at the Annual Meeting of the Society. The subject will be The Need for Standards for the Examination of Water-Borne Wastes, and L. K. Herndon will be the Symposium Chairman. He will write the introductory paper, and other papers will be presented by C. F. Hauck and G. D. Beal.

Inter-Society Corrosion Committee Formed

Fifteen delegates and three observers from technical organizations concerned with corrosion met in October, 1948, at A.S.T.M. headquarters, Philadelphia, Pa., to formulate the organization of the Inter-Society Corrosion Committee of the National Association of Corrosion Engineers. A plan of organization proposed by Sam Tour, Sam Tour & Co., Inc., A.S.T.M. delegate, was adopted. F. L. LaQue, president of N.A.C.E., acting as chairman of the meeting, called it to order and appointed C. S. Cole acting secretary.

The new committee's objectives were outlined in part during the meeting as follows:

1. To promote cooperation among various technical societies working in the field of corrosion.
2. To prepare and publish periodically a directory of corrosion workers in the United States.
3. To provide liaison among technical committees of N.A.C.E. and other technical societies.
4. To act in advisory capacity to technical societies interested in corrosion in an effort to promote progress of all and avoid duplication of effort.
5. To recommend in which society a proposed new activity might be carried out best without, however, attempting to define or limit the field of activity of any society.
6. To stimulate the publication of reliable data on corrosion and to provide publicity for conferences in this field.

The Inter-Society Committee will carry on some activities of the former American Coordinating Committee on Corrosion and the N.A.C.E. Committee on Relations with Other Technical Societies, both of which it has succeeded.

Significant decisions during the organization meeting included those which (*a*) established the principle that no working subcommittees of the new organization be formed to duplicate work of member societies' committees, (*b*) authorized formation of subcommittees covering items cutting across activities of several members, (*c*) instructed members to submit reports during January each year on corrosion activities being carried on or contemplated in their respective societies, (*d*) asked members to keep the committee posted on proposed meetings of their respective societies at which discussion of corrosion would be on the agenda.

Membership and Officers

Following are tentative rules relating to membership:

1. Any technical society working actively in corrosion is entitled to appoint two delegates to the committee. These need not be N.A.C.E. members personally but it is desirable they should be. Delegates terms of office shall be set by the society represented, but should be at least two but not more than six years.
2. Each United States and Canadian governmental agency actively working in the corrosion field may appoint one observer to the committee.
3. There shall be no other members.

The first election held in accordance with the rules of the committee resulted in the choice of the following officers: Dr. H. H. Uhlig, M.I.T., Cambridge, Mass., chairman; Sam Tour, Sam Tour & Co., Inc., New York City, vice-chairman; A. B. Campbell, executive-secretary N.A.C.E. secretary *ex-officio*.

Committee Organization

The main committee will have power to form subcommittees, members of which need not be delegate members of the inter-society or of N.A.C.E. Subcommittee reports will be submitted to

the main committee. Subcommittee members may attend meetings as observers, without voting privileges.

There shall be no dues.

Suggested activities of the intersociety committee included:

1. Continue work of the former ACCC subcommittee on standard terms and symbols and extend and revise the "Glossary of Terms Used in Corrosion," published in the ECS Corrosion Handbook.
2. Arrange for each member to submit annually a summary of current activities of his society for publication by the committee.
3. To serve as a nonexclusive means of communication between foreign organizations, individuals, and member societies.
4. To encourage and advise on courses on principles and practices of corrosion engineering in technical colleges.
5. To assist technical groups in getting authoritative speakers on corrosion.
6. To give advice, when asked, to organizations wishing to undertake or sponsor corrosion research.

ORGANIZATIONS AND THEIR DELEGATES REPRESENTED ON N.A.C.E. INTER-SOCIETY CORROSION COMMITTEE AS OF JANUARY 1949

ALLOY CASTING INSTITUTE, D. W. Talbott, Cooper Alloy Foundry Co.; J. W. Juppenlatz, Lebanon Steel Foundry.

AMERICAN GAS ASSOCIATION, R. F. Hadley, Susquehanna Pipe Line Co.; W. R. Fraser, Consolidated Gas Co.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, S. Logan Kerr.

ELECTROCHEMICAL SOCIETY, H. H. Uhlig, Corrosion Laboratory, Massachusetts Institute of Technology; K. G. Compton, Bell Telephone Laboratories.

NATIONAL BUREAU OF STANDARDS, J. G. Thompson.

NATIONAL DISTRICT HEATING ASSN., Leo F. Collins, Detroit Edison Co.

NATIONAL RESEARCH COUNCIL, F. N. Speller; J. C. Warner, Carnegie Institute of Technology.

AMERICAN SOCIETY FOR TESTING MATERIALS, C. D. Hocker, Union College; Sam Tour, Sam Tour & Co.; *Alternate*, C. S. Cole.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, L. J. Gorman, Consolidated Edison Co. of New York; H. M. Trueblood, Bell Telephone Laboratories.

TECHNICAL ASSOCIATION OF THE PULP & PAPER INDUSTRY, G. F. Pringle, Mead Corp.; C. G. Russell Johnson, Kimberly-Clark Corp.

AMERICAN CHEMICAL SOCIETY, G. H. Young, Mellon Institute of Industrial Research; R. M. Hunter, The Dow Chemical Co.

AMERICAN ELECTROPLATERS SOCIETY, K. M. Huston, Armco Steel Corp.; R. M. Wick, Bethlehem Steel Co.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, H. R. Copson, The International Nickel Co.; W. S. Loose, The Dow Chemical Co.

ASSOCIATION OF AMERICAN RAILROADS, G. M. Magee; W. F. Collins, New York Central System.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS, F. N. Speller.

AMERICAN SOCIETY FOR METALS, A. E. White, University of Michigan; T. S. Fuller, General Electric Co.

AMERICAN WATER WORKS ASSN., H. Lloyd Nelson, U. S. Pipe and Foundry Co.; Harry E. Jordan.

AMERICAN FOUNDRYMEN'S SOC., J. T. MacKenzie, American Cast Iron Pipe Co.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS, R. B. Mears, Carnegie-Illinois Steel Corp.

FEDERATION OF PAINT & VARNISH PRODUCTION CLUBS, Niel T. Phelps, Sinclair Refining Co.; Fred C. Weber, Jr., Phelan-Faust Paint Mfg. Co.

NATIONAL ASSOCIATION OF CORROSION ENGINEERS, R. B. Mears, Carnegie-Illinois Steel Corp.; F. L. LaQue, The International Nickel Co.

Unification of Screw Thread Standards—A Major Accomplishment

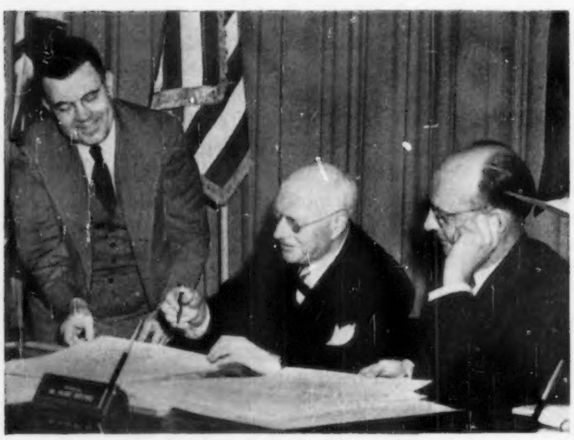
SOMEONE has said "Our whole machine-age economy actually is held together by screw threads."

It is significant then that on November 18, 1948, delegates and representatives from Government and industry of Canada, the United Kingdom, and the United States met at the National Bureau of Standards, Washington, D. C., to sign an accord on unification of the American and British standard systems of screw threads. The accord represented the culmination of 30 years of effort among the three nations. Not only is the accord of major significance in expanding and facilitating commerce between the cooperating nations, but it also is an important step toward the further development and extension of unifying standards in other fields of engineering practice.

Signers of the accord included: J. G. Morrow, Chairman, Canadian Standards Association, and senior vice-president of the American Society for Testing Materials; T. R. B. Sanders, Ministry of Supply, United Kingdom; Dr. E. U. Condon, Director of the National Bureau of Standards and Chairman of the Interdepartmental Screw Thread Committee of the United States; and W. L. Batt, Chairman, Sponsors Council of the United States and United Kingdom on the Unification of Screw Threads.

The significance of the accord is patent in the field of commerce. Almost all modern mechanisms and structures are held together by fasteners—bolts, nuts, screws, and rivets. To cite an extreme case, there are 122,000 screws in one type of airplane. Economic production in the automotive, aircraft, agricultural implement, and other industries using assembly-line methods requires not only a steady supply of components but also that the components, including large numbers of fasteners, be interchangeable so that they can be fitted together without selection, subsequent machining, or hand-fitting of any kind.

In the past, international trade in mechanisms of all kinds has been seriously handicapped by the lack of interchangeability of screw thread parts.



Left: J. G. Morrow Chairman, Canadian Standards Association and A.S.T.M. Vice - President, signing the accord; Dr. E. U. Condon, Director, National Bureau of Standards, looks on, standing. At Mr. Morrow's left is Mr. Hume Wrong, Canadian Ambassador.
Right: Dr. L. B. Tuckerman, assistant Chief, Mechanics Division, National Bureau of Standards, examines a screw thread specimen fractured in a fatigue test.

This has required the manufacturing nation also to supply and distribute such parts along with the equipment it wishes to market in a foreign area. Furthermore, the question of the availability of such parts has acted as a psychological deterrent to purchasers of products from other nations. These limitations on the international commerce of Canada, the United Kingdom, and the United States will gradually disappear as the unified standards are acted upon by the industries of the three Nations in the ensuing years.

During the first World War, the experience of allied American and British armed forces revealed that the lack of interchangeability of American and British screw threads was a serious problem. In World War II, the high degree of mechanization of all military forces made the problem even more serious than it had been. American industry was required to supply the British with a large volume of war equipment threaded to the British specification. This not only led to considerable delay but was economically disadvantageous. At the same time, American military forces based in England and using equipment with American threads found difficulties in making necessary replacements.

The three principal characteristics of screw threads are, (*1*) angle and form of thread, (*2*) pitch (the combinations of diameter and number of threads per inch for the various thread series), and (*3*) limiting dimensions (the manufacturing tolerances and allowances) for each grade of thread fit.

The British system is based on a thread angle of 55 degrees with a thread form having rounded crests and roots. The American system has a thread angle of 60 degrees with a thread form having flat crests and roots. The number of threads per inch for the various series of thread diameters was the same in both systems, with the exception of the half-inch coarse thread. Accurate fits between components having different thread angles were impossible. Moreover, the tolerances and allowances varied in the two systems.

The present unification agreement provides a 60-degree angle and a rounded root for screw threads. The crest of the external thread may be flat, as preferred in American practice, or rounded, as preferred by the British. The number of threads per inch for the various series of thread diameters has been unified, and the limiting dimensions for three grades of fit have been agreed upon. Thus, interchangeability of screw thread parts, based on the accord, now becomes feasible.

Assuring interchangeability of threaded products are the sizes agreed upon, the threads per inch, the basic dimensions of the unified coarse and fine thread series, together with the agreements that (1) the minimum internal thread shall be basic and the allowances (or minimum clearances on the flanks of the threads) shall be applied to the external threads and (2) tolerances shall be in the minus direction on the external thread and plus direction on the internal thread. Threaded parts of standard diameters and threads per inch, made in accordance with these principles, will always assemble freely.

There is, however, a further degree of interchangeability attained by agreements on the numerical values for allowances and tolerances, thereby setting limits to the least and greatest amounts of looseness between mating parts. Such agreement provides for identity of sizes (or interchangeability of use) of screw thread gages used in the different countries for controlling the limits of size of the threads. It also standardizes the grade or grades of fits between mating parts.

In one sense, the present accord marks the culmination of thirty years of work by the three nations toward the establishment of unification. In another sense, the accord marks the beginning of the realization of the unification. Purchases by the three governments will be based on the new stand-

Declaration of Accord

with respect to the

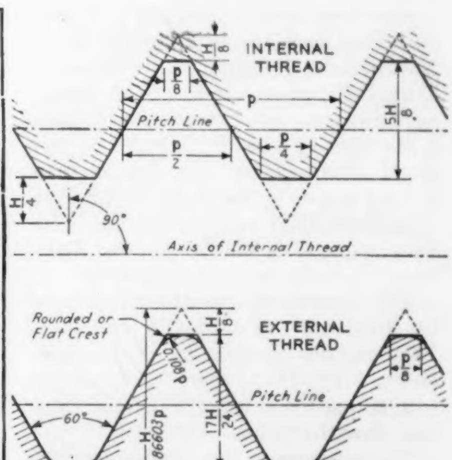
Unification of Screw Threads

It is hereby declared that the undersigned, representatives of their Government and Industry Bodies, charged with the development of standards for screw threads, Agree that the standards for the Unified Screw Threads given in the publications of the Committees of the British Standards Institution, Canadian Standards Association, American Standards Association and of the Interdepartmental Screw Thread Committee fulfill all of the basic requirements for general interchangeability of threaded products made in accordance with any of these standards.

The Bodies noted above will maintain continuous cooperation in the further development and extension of these standards.

Signed in Washington, D. C., this 18th day of November, 1948, at the National Bureau of Standards of the United States.

	Ministry of Trade and Commerce, Dominion of Canada
	Canadian Standards Association
T R B Sanders	Ministry of Supply, United Kingdom
	British Standards Institution
	Representative of British Industry
E U Condon	National Bureau of Standards U. S. Department of Commerce Interdepartmental Screw Thread Committee
	American Standards Association The American Society of Mechanical Engineers Society of Automotive Engineers
William L Batt	Sponsors Council of United States and United Kingdom on the Unification of Screw Threads



ards, but industrial use within the normal commerce of each of the nations will require a transformation of industrial practices, involving considerations of engineering, design, tooling, and production. Such a change will take time, but the transition should be completed in the next few years.

The present accord calls for a continuance of future cooperation in the field of screw thread standardization. Such cooperation has two aspects: first, the extension of the unification to the other English-speaking nations (all of which use the English system of measurement in manufacture) and, second, the continued development of standards. For standards are not static, and they must keep pace with improvements in materials and methods of production and inspection developed in industry. The reduction of the varieties of fasteners is one of the possibilities which further studies of standards and simplification may yield.

Meeting of ISO Committee on Rubber

THE International Organization for Standardization (ISO) Technical Committee 45 on Rubber held a meeting in London on June 28 and 29, 1948. The official report of this meeting has been received recently. Representatives from Australia, France, Italy, Netherlands, Poland, Switzerland, United Kingdom, and United States were present. American representatives at the meeting were Dr. L. A. Wood and H. G. Bimmerman. Mr. Bimmerman is very active in the work of A.S.T.M Committee D-11 and is chairman of its Subcommittee XXII on Cellular Rubbers.

ISO Technical Committee 45 on Rubber Products was set up in February, 1938, and one meeting was held in London in May of that year. The meeting in 1948 was the first one which had been held since that time.

The program of the meeting covered hardness tension stress-strain, abrasion, and tear resistance testing. Although complete agreement was not reached on any of the testing methods under consideration, progress was made and it may be expected that the next meeting will be productive of refined testing procedures. The standardization of these basic rubber tests should result in better understanding of rubber literature by rubber technologists throughout the world.

The next meeting of the committee will probably be held in Holland about the middle of 1949. Several of the members of the committee expressed a desire to hold a future meeting in the United States, probably during the annual A.S.T.M. meeting so that the delegates would have an opportunity to attend both meetings.

Top Technical Position Vacant at Engineer Research and Development Laboratories

APPLICATIONS are being reviewed for the senior scientific and technical position at the Engineer Research and Development Laboratories, Corps of Engineers, U. S. Army, Fort Belvoir, Va., as announced by the commanding officer, Colonel John C. Arrowsmith.

The newly created position, Director of Research and Development, is open to individuals with at least 15 years' experience, exclusive of graduate work, ten of which should have been in research or as a research or development engineer. Five of the 15 years' experience should have been as the chief of a branch or department of a research and development organization with administrative and technical responsibility.

The Director, who will receive a salary of $12,500 per year, will be chairman of the Research Council, a panel of some seven key technical personnel in the Laboratories whom he will guide in the prosecution of the ERDL research and development programs.

Responsibilities include all matters involving the technical and scientific aspects of the current research and development program in such varied fields as civil, electrical, mechanical, and military engineering, physics, and physical and organic chemistry. The Director will also be responsible for the maintenance of liaison, on high levels of authority with other Arms and Services, and with industrial and educational research organizations, and scientific and engineering societies.

The applicant for the position should be a leader in one of the major scientific fields included in the work of the Laboratories, as attested by the positions he has previously held, the caliber of the organizations with which he has been associated, and his published works.

Interested persons are invited to make application before April 15, either in person or by letter, setting forth their qualifications, to the Commanding Officer, Engineer Research and Development Laboratories, The Engineer Center and Fort Belvoir, Fort Belvoir, Va.

Course on Appearance Measurement

A SERIES of "Laboratory and Lecture Courses on Appearance Measurement" involving color and gloss and related properties is being given by the Henry A. Gardner Laboratory, Inc., 4723 Elm St., Bethesda 14, Md., under the direction of R. S. Hunter, Chief Optical Engineer. The first courses were given in February and later courses of 2- or 5-day duration are scheduled for March or April. The lecture subjects cover the fundamentals of appearance, both from the physical and psychological standpoint. They discuss instrument operation and instrument maintenance. The laboratory period will be devoted to actual examples of instrument operation and problems of maintenance.

Those interested are requested to contact the Gardner Laboratory for further information.

Forest Products Research Meeting

THE Third Annual National Meeting of the Forest Products Research Society will be held at the Civic Auditorium in Grand Rapids, Mich., May 2 to 4, inclusive. Six technical sessions have been scheduled, and the subjects to be discussed include: raw material and its preparation; furniture and plywood; chemical utilization of wood; machining of wood; technical development of research; and seasoning. An exhibit will be held in conjunction with this meeting and is open to all industries engaged in the production, development, or utilization of forest products. The meetings and exhibits are open to members and nonmembers.

Publications of the National Bureau of Standards, 1901 to June 30, 1947

CIRCULAR 460, *Publications of the National Bureau of Standards*, listing all Bureau publications from 1901 to June 30, 1947, has recently become available. The National Bureau of Standards is the principal agency of the Federal Government for fundamental research in physics, mathematics, chemistry, and engineering. Its activities include research in electricity, electronics, atomic physics, applied mathematics, mechanics and sound, radio and radio propagation, optics, heat and power, metallurgy, metrology, ordnance, physical chemistry, mineral products, organic and fibrous materials, and building technology. The Bureau also has custody of the national standards of physical measurement and conducts research leading to the improvement of these standards and techniques of measurement. Improved methods of testing materials and equipment are developed, physical constants and properties of materials are determined, and technical processes are investigated.

Bureau publications listed in the Circular include Mathematical Tables, Building Materials and Structures Reports, Circulars, Handbooks, Commercial Standards, Simplified Practice Recommendations, Research Papers, and Miscellaneous Publications. Brief abstracts for the publications issued from January 1, 1942 to June 30, 1947, are also included. Circular 460, 375 pages, can be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 75 cents a copy.

New Members to February 25, 1949

The following 108 members were elected from January 4, 1949, to February 25, 1949, making the total membership 6472.

Names are arranged alphabetically—company members first, then individuals.

Chicago District

BOIAN, W. O., Structural Engineer, Pittsburgh-Des Moines Steel Co., 1015 Tuttle St., Des Moines 8, Iowa.

CLARK, RALPH A., Metallurgical Engineer, Development, Electro Metallurgical Division, Union Carbide and Carbon Corp., 230 N. Michigan Ave., Chicago 1, Ill.

COOK, RALPH L., Professor of Ceramic Engineering, University of Illinois, 204 Ceramics Bldg., Urbana, Ill.

DANIELS, JOHN C., Engineer, Soils, U. S. Department of the Army, Corps of Engineers, Great Lakes Division, 1660 E. Hyde Park Blvd., Chicago 15, Ill. For mail: 3014 Eighth Ave., North, Billings, Mont.

DROW, JOHN T., Engineer, U. S. Forest Products Laboratory, Madison 5, Wis.

HOOPER, WILLIAM T., JR., Assistant Professor of Civil Engineering, Northwestern University, Department of Civil Engineering, Evanston, Ill.

HOUNCHELL, HELEN A., Textiles and Home Furnishings Editor, Household Finance Corp., 919 N. Michigan Ave., Chicago 11, Ill.

KEENEY, W. D., Engineer, Service Bureau, American Wood-Preservers' Assn., Room 1804, 111 W. Washington St., Chicago 2, Ill.

PETERSEN, FREDERICK A., Special Research Professor of Ceramic Engineering, University of Illinois, Department of Ceramic Engineering, Urbana, Ill.

SAMSON, CHARLES H., JR., Civil Engineer Architects' Field Representative, Indianwood, Sauk Trail, Matteson, Ill. [J]*

WORK, CLYDE E., Instructor in Theoretical and Applied Mechanics, University of Illinois, 220a Talbot Lab., Urbana, Ill. [J]

Cleveland District

ABERSOLD, A. F., Specification and Claims Engineer, National Tube Co., Lorain Works, Lorain, Ohio.

BROWN, WILLIAM F., JR., Research Scientist in Physical Metallurgy, NACA Flight Propulsion Lab., Cleveland Airport, Cleveland, Ohio. For mail: 1461 St. Charles Ave., Lakewood 7, Ohio. [J]

HILL, JOHN, Empire Steel Co., Mansfield, Ohio.

KOENITZER, ROLLAND D., Assistant Chief Engineer, Brown Fintube Co., 300 Huron St., Elyria, Ohio.

LEE, HARLEY C., Vice-President and Technical Director, Basic Refractories, Inc., 845 Hanna Bldg., Cleveland 15, Ohio.

WAUGH, RICHARD B., Assistant General Supervisor of Design, Carnegie-Illinois Steel Corp., 912 Salt Springs Rd., Youngstown, Ohio.

Detroit District

DETROIT TESTING LABORATORY, THE, Douglas Dow, President, 554 Bagley Ave., Detroit 26, Mich.

DEGRAW, O. I., Process Engineer, Gibson Refrigerator Co., Greenville, Mich.

HICKS, GLENN H., Technical Director, Acme White Lead and Color Works, 8250 St. Aubin, Detroit 11, Mich.

STEVENSON, M. BRADLEY, Salesman, Port Huron Sulphite and Paper Co., Port Huron, Mich. For mail: Room 1733, 400 W. Madison St., Chicago, Ill.

New England District

CONSOLIDATED BRICK SALES, INC., H. M. Spaulding, President, 217 Newbury St., Boston 16, Mass.

BAILEY, WAYLAND S., Assistant Professor of Mechanical Engineering, Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge 39, Mass. For mail: Box 37, River St., Norwell, Mass.

LEMMERMAN, CARL W., President and Owner, Industrial Sound Control, 45 Granby St., Hartford 5, Conn.

MURPHY, E. L., JR., Division Manager, Laboratory and Sample, Brown Durrell Co., 75 Cambridge Parkway, Cambridge 42, Mass.

New York District

LAMINAR CALCIUM CORP., E. E. Eakins, 271 North Ave., New Rochelle, N. Y.

MCLELLAN STORES CO., George E. Mackey, Architect, 55 Fifth Ave., New York 3, N. Y.

SPERRY PRODUCTS, INC., J. C. Smack, Sales Engineer, Shelter Rock Rd., Danbury, Conn.

DAHLSTROM, ROY, Technical Director, National Lead Co., Titanium Division, Box 58, South Amboy, N. J.

SANDLER, ROBERT ARTHUR, Fuels Chemist, New York Testing Laboratories, 80 Washington St., New York, N. Y. For mail: 1824 E. Fifteenth St., Brooklyn 29, N. Y. [J]

SHAW, MYRIL CLEMENT, Research Engineer, Asbestos Textile Inst., School of Ceramics, Rutgers University, New Brunswick, N. J.

SIEGEL, MELVIN, Plant Manager, Jean Ribbon Co., 258 Atlantic St., Paterson, N. J. For mail: 90 Elmwood, Terrace, East Paterson, N. J. [J]

STEINBERG, ALBERT, Assistant Chemical Engineer, Roddis Plywood Corp. Marshfield, Wis. For mail: 730 W. 183rd St., New York 33, N. Y. [J]

STEPHENSON, LAURENCE E., Chief Engineer, Frederick Snare Corp., 233 Broadway, New York 7, N. Y.

STOUT, HERSCHEL L., Engineer, Signal Corps Engineering Laboratories, Ft. Monmouth, N. J. For mail: 564 Sairs Ave., Long Branch, N. J.

WARD, JOSEPH S., JR., Instructor in Civil Engineering, Department of Civil Engineering, Cooper Union, Cooper Square, New York 3, N. Y. [J]

WEINER, MILTON, Production Engineer, Allied Textile Printers, Inc., 45 Warren St., Paterson, N. J. For mail: 2264 Grand Ave., The Bronx 53, N. Y. [J]

Northern California District

CURTIS & TOMPKINS, LTD., H. de Bussieres, Vice-President and Manager, 236 Front St., San Francisco 11, Calif.

CONTRA COSTA COUNTY BUILDING INSPECTION DEPARTMENT, R. J. Kraintz, Chief Building Inspector, 231 Hall of Records Bldg., Martinez, Calif.

STOCKTON, CITY OF, Marshall Dunlap, City Engineer, City Hall, Stockton 3, Calif.

VOLLMAR, RALPH C., Refinery Chief Chemist, Standard Oil Company of California, Richmond, Calif. For mail: 988 Creston Rd., Berkeley 8, Calif.

Ohio Valley District

(In Course of Organization)

BUCKEYE STEEL CASTINGS CO., THE, F. H. Bonnet, President and General Manager, S. Parsons Ave., Columbus 7, Ohio.

HARRIS, JAY C., Research Group Leader, Monsanto Chemical Co., Nicholas Rd., Dayton 7, Ohio.

PEACOCK, JEANETTA, Owner, Industrial Oils Laboratory, 3305 E. Michigan St., Indianapolis 1, Ind.

Philadelphia District

BASS, FRANK L., Chief Chemist, Keystone Portland Cement Co., Bath, Pa.

BERNADOS, JOHN E., Staff Assistant, American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. For mail: 15 S. Woodlawn Ave., Aldan, Pa. [J]

CLARK, JOHN DOUGLAS, Ceramic Engineer, Foote Mineral Co., 4041 Ridge Ave., Philadelphia 29, Pa.

DUDLEY, ALBERT WILLARD, Materials Engineer, Allentown Testing Laboratory, Inc., 380 Linden St., Allentown, Pa.

HILL, CHARLES E., Engineering Trainee, Pusey & Jones Corp., Wilmington 99, Del. For mail: 810 E. Ninth St., Chester, Pa. [J]

REID, CARL R., District Materials Engineer, Pennsylvania Turnpike Commission, Materials Div., 11 N. Fourth St., Harrisburg, Pa.

RESEARCH INSTITUTE OF TEMPLE UNIVERSITY, A. V. Grosse, President, Broad St., and Montgomery Ave., Philadelphia 22, Pa.

UHLMANN, DAVID H., JR., Instructor in Civil Engineering, Towne Scientific School, University of Pennsylvania, Thirty-third and Locust Sts., Philadelphia, Pa. For mail: 4035 Spruce St., Philadelphia 4, Pa. [J]

Pittsburgh District

INSUL-MASTIC CORPORATION OF AMERICA, Harry E. Rapp, Technical Engineer, 1144 Oliver Bldg., Pittsburgh 22, Pa.

NATIONAL CARBIDE DIE CO., James F. Ednie, Metallurgical Engineer, Greenock Rd., McKeesport 2, Pa.

STUPAKOFF CERAMIC AND MANUFACTURING CO., E. H. Fritz, Vice-President, Manufacturing, Latrobe, Pa.

BRADSHAW, JOSEPH G., Chemical Engineer, Koppers Co., Inc., Koppers Bldg., Pittsburgh 19, Pa.

CARNEGIE LIBRARY OF PITTSBURGH, Morris Schrero, Technology Librarian, 4400 Forbes St., Pittsburgh 13, Pa.

CHAPEL, KARL F., Sales Engineer, J. K. Davison and Brother, Forty-second and Davison Sts., Pittsburgh 1, Pa.

COOPER, S. M., Director, Merchandise Research Department, G. C. Murphy Co., 531 Fifth Ave., McKeesport, Pa.

PINNEY, M. A., Engineer of Tests, The Pennsylvania Railroad Co., Altoona, Pa.

SHERWIN, J. PAUL, Chief Inspector, Carnegie-Illinois Steel Corp., Homestead Steel Works, Munhall, Pa.

TOMLINSON, WILLIAM HENRY, Chemical Engineer, Owens-Corning Fiberglas Corp., Huntingdon, Pa. For mail: 206 Second St., Huntingdon, Pa.

WRIGHT, CALVERT C., Professor and Chief, Division of Fuel Technology, The Pennsylvania State College, State College, Pa.

YEWELL, J. E., Chief Engineer, Bessemer and Lake Erie Railroad Co., Greenville, Pa.

St. Louis District

MCHARG, ROBERT E., Engineer, Finney & Turnipseed, Consulting Engineers, 624 New England Bldg., Topeka, Kans. For mail: 1507 Huntoon, Topeka, Kans. [J]

RODGERS, EBEN, JR., President, Alton Brick Co., Box 394, Alton, Ill.

SPEER, ALEXANDER C., Engineer, Arabian American Oil Co., Saudi, Arabia. For mail: Box 1100, Fayetteville, Ark.

Southern California District

BRADLEY, F. E., Superintendent, Coline Gasoline Corp., 4549 Produce Plaza West, Los Angeles 11, Calif.

PEROW, ROBERT H., Quality Control Supervisor, Johns-Manville Products Corp., Box 1450, Long Beach 1, Calif.

VOELKER, J. F., Assistant to Works Manager, Riverside Cement Co., Box 832, Riverside, Calif.

Washington (D. C.) District

CARLTON, E. TUCKER, Architect, 1009 E. Main St., Richmond 19, Va.

CHAIKEN, BERNARD, Associate Chemist, Division of Physical Research, Public Roads Administration, Washington 25, D. C.

CZECHOSLOVAK RESEARCH INST., Josef Schejbal, Brigadier General, Prague, Czechoslovakia. For mail: 2349 Massachusetts Ave., N. W., Washington 8, D. C.

GEORGE WASHINGTON UNIVERSITY, THE, SCHOOL OF ENGINEERING, Bruce D. Greenshields, Professor of Civil Engineering, Washington 6, D. C.

LORDLEY, H. E., Assistant Director, Department of Public Utilities, City of Richmond, Room 317, City Hall, Richmond, Va.

MIDDAUGH, G. V., Manager, General Engineering, Koppers Co., Inc., Metal Products Div., Box 298, Baltimore 3, Md.

POLLARD, ROLLA E., Metallurgist, National Bureau of Standards, Washington 25, D. C.

PORTER, F. WARREN, Paint Chemist, Color Craft Corp., 1537 Ridgely St., Baltimore 30, Md. For mail: 116 Oakdale Ave., Catonsville 28, Md. [J]

RETZ, ROLF T., Civil Engineering and Estimator, Virginia Engineering Co., Inc., Newport News, Va. For mail: 404 Shenandoah Rd., Hampton, Va.

STONE, A. B., Chief Engineer, Norfolk & Western Railway Co., Roanoke 17, Va.

Western New York-Ontario District

FEIGEL, JOHN H., Consulting Engineer, 38 Dakota St., Apt. 5, Buffalo 16, N. Y.

IRWIN, R. E., Chief Chemist, The British American Oil Co., Ltd., Toronto, Ont., Canada.

JOHNSON, NEWTON H., Chemical Engineer, Electro Metallurgical Division, Union Carbide and Carbon Corp., Niagara Falls, N. Y. For mail: 606 Walnut Ave., Niagara Falls, N. Y. [J]

MCLEOD, NORMAN W., Asphalt Technologist, Department of Asphalt Technology, Imperial Oil, Ltd., 56 Church St., Toronto, Ont., Canada.

WILLIS, JOHN F., Technical Director, McDougall-Butler Co., Inc., 6 Evans St., Buffalo 5, N. Y.

U. S. and Possessions

DIXIE COTTON MILLS, THE, B. W. Whorton, Vice-President, LaGrange, Ga.

BELL, RICHARD, Vice-President and General Manager, Bell Clay Co., Gleason, Tenn.

ELSTNER, RICHARD CHESNEY, Instructor in Materials, University of Hawaii, Box 18, Honolulu 10, T. H. [J]

MYERS, E. V., Superintendent, Motive Power, St. Louis Southwestern Railway Co., Pine Bluff, Ark.

RICE INSTITUTE LIBRARY, THE, Box 1892, Houston 1, Tex.

SELLS, WILLIAM S., Vice-President, General Shale Products Corp., Johnson City, Tenn.

STACKHOUSE, A. K., Sales Engineer, T. L. Herbert and Sons, 174 Third Ave., North, Nashville, Tenn.

Other than U. S. Possessions

DORCH, BACKSIN AND COS. AB, Hugo Andersson, Norra Hamngatan 24, Gothenburg, Sweden.

ANTIA, DARA P., Development Officer (Metals), Directorate General of Industry and Supply, Shahjahan Rd., New Delhi, India. For mail: Honorary Secretary, Indian Institute of Metals, 23-B, Netaji Subhas Rd., Calcutta, India.

ARBEL, CLAUDE L., Scientific Adviser, Societe Francaise de Materiel Agricole and Industriel, Paris, France. For mail: 4 Av. d'Eylau, Paris XVI, France. [J]

CAMPBELL, WILSON WILLIAM, Senior Engineer, Merz & McLellan, Carliol House, Newcastle Upon Tyne 1, England.

DINNER, HEINRICH, Head of Material Testing Dept., Sulzer Brothers, Ltd., Seidenstrasse 49, Winterthur, Switzerland.

GILL, SARUP SINGH, Metallurgist, Indian Steel and Wire Products Co., Ltd., Indra Nagar, Tatanagar, India.

GOOSSENS, PIERRE J., J. Van Den Heuvel Cement Co., Hemixem, Antwerp, Belgium. For mail: 204 Amerikalei, Antwerp, Belgium. [J]

INSPECCAO GERAL DOS PRODUTOS AGRICOLAS E INDUSTRIAIS, Ministerio da Economia, Avenida de Berna 85, Lisbon, Portugal.

KADDAH, HAMED, Consulting Engineer, Royal Egyptian Engineering Society, 28 Sharia Malika Nazli, Cairo, Egypt.

LEDOCQ, MARCEL H., Chief Engineer, Ateliers de Constructions Electriques de Charleroi, 131 Avenue Eugene Mascaux Marcinelle, Belgium.

MACKIE, W. F. C., Shell Company of Venezuela, Las Piedras, Estado Falcon, Venezuela.

MACTAGGART, E. F., Managing Director, MacTaggart & Evans, Ltd., Sondes Place Research Inst., Dorking, England.

ROYAL EGYPTIAN ENGINEERING SOCIETY, 28 Sharia Malika Nazli, Cairo, Egypt.

SCHEIN, CHARLES, Graduate Student, Institut Francais du Caoutchouc, Laboratory 16, 42 rue Scheffer, Paris XVI*, France. [J]

STEEVES, WESLEY M., Chief Assessor and Assistant Town Manager, Town of Woodstock, Box 173, Woodstock, N. B., Canada.

YOUNG, JOHN PATERSON, Head of Analytical Laboratories, Scottish Oils, Ltd., Middleton Hall, Uphall, Broxburn, West Lothian, Scotland.

* [J] denotes Junior Member.

PERSONALS • • •

News items concerning the activities of our members will be welcomed for inclusion in this column.

NOTE—*These "Personals" are arranged in order of alphabetical sequence of the names. Frequently two or more members may be referred to in the same note, in which case the first one named is used as a key letter. It is believed that this arrangement will facilitate reference to the news about members.*

Members Retiring

AT THE beginning of each year we receive information from an increasing number of our long-time members that they are retiring from active work or are easing their industrial loads in some way, and in a number of these cases the men feel that they must reduce or discontinue entirely their activity in A.S.T.M. It seems appropriate to note the names of a number of these men, to give some idea of their length of membership in the Society and to extend them best wishes and appreciation for their interest in the Society. Based on information reaching us in various ways, the following men are retiring from A.S.T.M. work, and we believe in most cases are dropping their industrial contacts, although some of the men are continuing with some consulting activities. The date of membership in A.S.T.M. is given, as well as the former connection.

	Date of Membership
Comfort A. Adams, Harvard University	1920
Charles M. Baskin, Imperial Oil, Ltd.	1919
A. W. K. Billings, Brazilian Traction, Light and Power Co.	1915
Edwin A. Boyd, University of Michigan	1922
Frederick J. Griffiths, Steel Consultant	1915
Addison F. Holmes, Massachusetts Institute of Technology	1906
A. H. Jameson, Malleable Iron Fittings Co.	1917
George T. Johnson, Buckeye Steel Castings Co.	1916
James S. MacGregor, Miscellaneous Minerals Division, Federal Government Service	1910
E. H. McClelland, Carnegie Library of Pittsburgh	1912
A. Nadai, Westinghouse Electric Corp.	1934
J. B. Rather, Socony-Vacuum Oil Co., Inc.	1919
Clarence W. Rust, Armco Steel Corp.	1920
H. H. Scofield, Cornell University	1908
Ambrose H. Stang, National Bureau of Standards	1922
Charles W. Walker, American Steel and Wire Co.	1921
A. R. Wilson, Pennsylvania Railroad Co.	1929
William P. Wiltsee, Norfolk & Western Railway	1920
Henry Wysor, Bethlehem Steel Co.	1929

Mr. Baskin has served on several A.S.T.M. technical committees, as has Mr. Jameson, the latter having been particularly active in some of the metals groups. Dr. Rather served on a number of groups, notably Committee D-2 on Petroleum, and is a former member of the Board of Directors. Professor Scofield has contributed of his time and knowledge to the work of a number of the A.S.T.M. committees, and Messrs. Adams, Johnson, Rust, Walker, Wilson, and Wysor also have a record of constructive technical committee service, Mr. Wysor having been active in Committee A-1 on Steel, a subcommittee chairman and A-1 secretary.

Anthony L. Alesi, formerly Chemical Engineer, Plastics Laboratory, Princeton University, is now on the Chemical Engineering Staff of the Philadelphia Quartermaster Depot.

Harold R. Alley has accepted an appointment as Sales Engineer, Mid-States Gummed Paper Co., Chicago, Ill. He was previously Chief Chemist, Mystik Adhesive Products, Division of Chicago Show Printing Co.

Aluminum Company of America, New Kensington, Pa., has announced the promotion of two of the company's Cleveland staff of research scientists. **Kent R. Van Horn,** Chief of the Cleveland Branch of Aluminum Research Laboratories since November, 1945, has been named an Assistant Director of Research for the company. **Maurice W. Daugherty,** Assistant Chief of the Cleveland Laboratories during the same period, succeeds Dr. Van Horn as Chief. One of the nation's outstanding metallurgists, and an authority in the field of industrial X-ray, Dr. Van Horn will remain in Cleveland, where he will continue to devote his talents to the improvement of

Alcoa casting and forging processes and alloys. Mr. Daugherty, similarly prominent in metallurgical circles, and in research into the corrosion of light metals, will supervise laboratory staff work.

Paul Archibald is now Chief Metallurgical Engineer, Standard Steel Works Div., Baldwin Locomotive Works, at Burnham, Pa. He succeeds G. S. Baldwin as official representative of his company's membership, and will serve on several subcommittees of Committee A-1 on Steel.

Atlas Mineral Products Co., Mertztown, Pa., has announced that Raymond B. Seymour, formerly Chief Chemist for this firm, has returned as Executive Vice-President and General Manager. One of Dr. Seymour's assignments will be the direction of research toward the improvement and development of new protective coatings, linings, and cements for the chemical, metal processing, steel, petroleum, rayon, food, paper, leather, and textile industries.

Earl F. Bennett, formerly Principal Soils Engineer, New York State Department of Public Works, Bureau of Soil Mechanics, Albany, is now affiliated with the Koppers Co., Inc., Tar Products Div., Pittsburgh, Pa.

Maurice H. Bigelow has been named Technical Director of Plaskon Division of Libbey-Owens-Ford Glass Co., Toledo, Ohio. In his new post Dr. Bigelow will have full responsibility for both technical service and research activities. He joined the Plaskon organization in 1933 and since then had been Director of Technical Service, having been actively identified in the development of urea formaldehyde molding material and glues, in which field he holds a number of patents.

R. C. Brumfield, formerly Associate Professor of Civil Engineering, Cooper Union, has been appointed Director of Research, J. F. Jelenko Co., New York City. Dr. Brumfield is one of our long-time members, having become affiliated with A.S.T.M. in 1919.

John D. Calkin, New York City, has been appointed Director of the Department of Industrial Cooperation, and Associate Professor of Chemical Engineering at the University of Maine. Professor Lyle Jenness, who has been Acting Director of the Department of Industrial Cooperation, will devote his full time to his duties as Head of the Department of Chemical Engineering. From 1943 to 1948 Mr. Calkin was Coordinator of Research for the Union Bag and Paper Corp. Recently he established himself in New York City as a consultant to the pulp and paper and chemical process industries. He will continue to maintain offices at 500 Fifth Ave., New York City 18.

Past-President **Arthur W. Carpenter,** who has been on leave of absence from The B. F. Goodrich Co. to assist the National Security Resources Board, where he has served four months as Assistant Director of the Board's Office of Production, was presented on February 1 with the National Security Resources Board's Distinguished Service Award. The presentation was made by R. E. Gillmor, Vice-Chairman of NSRB, at a farewell reception given in Mr. Carpenter's honor at the Officers Club at Fort McNair, seat of the War College in Washington. The award was in recognition of Mr. Carpenter's "outstanding contributions to the work of the National Security Resources Board and devotion to the welfare of his country." The citation read at the time of the presentation referred to Mr. Carpenter's service to his country in World War I and as an official of the War Production Board in World War II. In his recent work in the NSRB, Mr. Carpenter did much to define the internal and external channels of responsibility for raw materials problems and for stockpiling, without which no constructive work could proceed. His survey of the stockpile problem—issued as NSRB Document 102—proved to be of great value to all those concerned with stockpiling. In addition, he has laid the groundwork for an intelligent approach to the formulation of national materials policies needed to guarantee the establishment of adequate reserves of strategic and critical materials

Henry J. Cohn is now Textile Chemist, Silcot Mfg. Co., Inc., New York City. He was previously associated with Bordow Co., Inc., of the same city, in a similar capacity.

James F. Ednie, formerly Chief Metallurgist with the Duquesne Smelting Corp., Pittsburgh, recently liquidated, is now Sales Manager for the National Carbide Die Co., McKeesport, Pa. Mr. Ednie represented the Duquesne Corp. on various technical committees, and anticipates continuation of certain contacts as representative of the National Carbide Die Co., the latter company now having qualified as a member of the Society.

Norris D. Embree has been appointed Director of Research at Distillation Products, Inc., Rochester, N. Y. Dr. Embree had been Acting Research Director for several months.

Alexander L. Feild, Associate Director, Research Laboratories, Rustless Iron Division, American Rolling Mill Co., recently received the honorary degree of Doctor of Science from the Stevens Institute of Technology, Hoboken, N. J.

R. T. Goodwin, Manager of Shell Oil Co.'s Aviation Dept. since 1941, has been named Manager of the company's Special Products Dept. in New York, to succeed R. S. Mitchell, who has been transferred to the St. Louis Marketing Division of the company.

L. C. Hewitt, Director of Research, Laclede-Christy Clay Products Co., St. Louis, Mo., was recently presented with a gold watch by his company for long service. Mr. Hewitt has been with Laclede-Christy for 31 years, serving in the Industrial Engineering Dept. for six years, and becoming Research Director in 1923, a post which he has held continuously since that time. He was elected Company Vice-President in 1943. Mr. Hewitt is a long-time A.S.T.M. member, an active member of Committee C-8 on Refractories, and of the St. Louis District Council.

Frank H. Jackson, Honorary Member, A.S.T.M., Vice-President, American Concrete Institute, and Principal Engineer of Tests, Public Roads Administration, Washington, D. C., and **Charles H. Scholer,** Professor of Applied Mechanics, Kansas State College, have been presented the Distinguished Service Award of the Highway Research Board for outstanding achievement in the field of highway research. Both Mr. Jackson and Professor Scholer have been affiliated with A.S.T.M. for many years, and are active in the work of Committees C-9 on Concrete and C-12 on Mortars for Unit Masonry.

Theodore J. Kauer, formerly Managing Director of the Wire Reinforcement Institute, Washington, D. C., has been appointed Director of Highways for the State of Ohio.

John N. Kenyon, formerly Research Engineer, Columbia University, is now at Princeton University, Princeton, N. J.

The **Kester Solder Co.,** Chicago, Ill., recently celebrated its Golden Anniversary. Starting in business in January, 1899, as the Kester Electric Manufacturing Co., the name was changed to Chicago Solder Co. in 1905, and in 1929 the present name was assumed. During its recent anniversary month appropriate and interesting advertising noting the progress of the company appeared in numerous trade and consumer publications. Attention was called to the fact that the present type of cored solder used by industry was first made by J. F. Kester in 1899, and those interested were invited to write the company for a free 28-page manual, "Solder and Soldering Technique," giving complete analysis of the application and properties of soft solder alloys and soldering fluxes. **Frank C. Engelhart,** as President of the company, expressed appreciation to customers, suppliers, and other friends for many years of pleasant associations.

H. B. Knowlton, Materials and Standards Engineer, International Harvester Co., Chicago, has been named Chairman of the Engineering Materials Activity of the SAE Iron and Steel Technical Committee for 1949.

Hugo C. Larson, formerly Assistant Metallurgical Engineer, Bethlehem Steel Co., Bethlehem, Pa., has been appointed Metallurgical Engineer. His duties will be to serve as secretary of all of the company's plant operating and technical committees. Mr. Larson is secretary of A.S.T.M. Committee A-1 on Steel and active in the work of a number of subcommittees.

E. A. Ledyard, Research Chemist, Monolith Portland Cement Co., Monolith, Calif., has been made Chairman of the General Technical Committee of the Portland Cement Association, Chicago, Ill.

Dr. Morris E. Leeds, Chairman of the Board of Leeds & Northrup Co., Philadelphia, Pa., and in the early years of this company the representative in A.S.T.M. of its membership, received one of the nation's top engineering honors, The Edison Medal, at the February winter general meeting of the A.I.E.E. in New York City. Awarded for meritorius achievement in electrical science, Dr. Leeds received the medal "for his con-

tributions to industry through development and production of electrical precision measuring devices and controls." Dr. Leeds has received many awards and honors in recognition of his outstanding contributions to industry and to his community. He has rendered notable services in Philadelphia's Board of Education and is a past-president of that important group.

D. S. MacBride, formerly Executive Vice-President, has been elected President of **Hercules Cement Corp.,** Philadelphia, Pa., to succeed **Joseph Brobston,** who was named Board Chairman. The Board's action completed a management shift that was started a year ago at the request of Mr. Brobston, who is in his 50th year as a cement manufacturer. This year also is Mr. Brobston's 40th year of continuous membership in A.S.T.M. Mr. MacBride has been active in the cement industry for 30 years in both sales and managerial capacities, and has been representative of his company's A.S.T.M. membership for several years.

Albyn Mackintosh, Consulting Engineer in Los Angeles, Calif., has been named an honorary member of the Concrete Masonry Manufacturers Association of Southern California.

Louis McDonald, formerly Research Supervisor, Dept. of Chemical Engineering, California Institute of Technology, Pasadena, is now Head, High Explosives Section, U. S. Naval Ordnance Test Station, Inyokern, Calif.

The **Metal Lath Manufacturers Assn.,** Cleveland, Ohio, has announced the appointment of **William B. Turner** as Commissioner. Mr. Turner replaces **Donald R. Wadle,** who had held the position as Commissioner for the Association since October, 1946, and had been obliged to curtail his activities last year because of illness. Mr. Wadle, who was previously Pacific Coast representative of the Metal Lath Manufacturers Assn. and also in charge of the Contracting Plasterers and Lathers Assn. of Southern California, will remain with M.L.M.A. as Technical Director, devoting much of his time to building code work. Mr. Turner, the recently appointed Commissioner, has been active in the sale of metal lath for nearly 40 years, having held positions as sales amanger of several of the more important metal lath manufacturers.

Carl Shelley Miner, has been awarded the 1949 Perkin Medal of the American Section of the Society of Chemical Industry, given annually for outstanding work in applied chemistry. In his address as the forty-third recipient of the medal, Mr. Miner discussed "Science *versus* Starvation." In 1906 he established the Chicago laboratories bearing his name, which consulting institution has become an important part of the industrial structure of the midwest. As one of the foremost exponents of the potentialities of the field of "Chemurgy," his dream in 1920 that annual crops could be a source of chemicals matured into furfural, the widely used solvent.

Stephen A. Montanaro, formerly Materials Engineer, American District Telegraph Co., New York City, is now Managing Director, City Testing & Research Laboratories, Inc., of the same city.

William M. Murray, Jr., has been named permanent Director of the Southern Research Institute, Birmingham, Ala. Dr. Murray was previously Analytical Chemist, and had served as acting Director since the retirement of Wilbur A. Lazier last year.

Don O. Noel, formerly Plant Engineer, Metals Disintegrating Co., Inc., Elizabeth, N. J., is now associated as Engineer with the Wah Chong Smelting & Refining Co., Long Island, N. Y.

W. M. Peirce, Chief, Research Division, New Jersey Zinc Co., Palmerton, Pa., has been elected a Director of the American Institute of Mining and Metallurgical Engineers.

Fred P. Peters, who for several years has been Associate Publishing Director of the Book Division, and Editor-in-Chief, *Materials & Methods*, Reinhold Publishing Corp., has been elected Vice-President of the Corporation and Publishing Director of the Book Division. In addition to directing Reinhold's book publishing activities in the chemical, metallurgical, architectural, and other technical fields, he will continue with *Materials & Methods* as Editorial Director.

Portland Cement Association has announced the advancement of **Harrison F. Gonnerman,** former Director of Research, to the position of Assistant to the Vice-President for Research and Development. Mr. Gonnerman fills the vacancy created by the retirement from active service of **F. R. McMillan,** who had held that post since January, 1947, and who had been with the Association since 1924. A graduate of the University of Minnesota, Mr. McMillan is a Past-President of the American Concrete Institute, a member of many technical groups and author of numerous papers on cement and concrete research. He has been affiliated with A.S.T.M. for 30 years, and has rendered very active service on Committee C-9 on Concrete and Concrete Aggregates, having been elected an Honorary Member of that Committee in 1947. Mr. Gonnerman likewise is a long-time A.S.T.M. member, having joined the Society in 1914, and has been an active representative of the P.C.A. on Committee C-1 on Cement for many years. He has been with the Association since 1922, having served in various capacities, and has twice received the Wason Medal of the American Concrete Institute for noteworthy research. **Hubert Woods,** former Research Director of the Riverside Cement Co. of Los Angeles, Calif., succeeds Mr. Gunnerman as Director for Research for P.C.A. He too is a member of long standing in A.S.T.M., and has participated in activities of Committee C-1 since 1934. A graduate of the California Institute of Technology, he is the author of various technical papers on cement and cement manufacture.

Carl R. Reid, formerly Engineer of Materials and Tests, Oklahoma State Highway Commission, Oklahoma City, is now District Materials Engineer, Pennsylvania Turnpike Commission, Harrisburg, Pa.

Frederick N. Rhines, Associate Professor of Metallurgy, Carnegie Institute of Technology, Pittsburgh, Pa., has been elected a Director of the American Institute of Mining and Metallurgical Engineers.

Roscoe Hall Sawyer has been appointed Assistant Chemical Director of Devoe & Raynolds Co., Inc., Louisville, Ky. Mr. Sawyer had been affiliated with E. I. du Pont de Nemours & Co., Inc., for the past eighteen years, having specialized in pigment-physics.

A. O. Schaefer, for many years Executive Metallurgical Engineer, The Midvale Co., Philadelphia, was recently advanced to the position of Assistant to the Executive Vice-President. Mr. Schaefer serves as representative of his company in A.S.T.M. and on Committee A-1 on Steel, also has been an active member of the Philadelphia District Council, of which group he is presently Chairman, having rendered service as Vice-Chairman from 1946 to 1948. He has been doing very intensive work in Committee A-1's subcommittee in forgings.

Jerome Sherman, formerly Experimental Engineer, Bacharach Industrial Instrument Co., Pittsburgh, Pa., is now Asst. Test Engineer, The Babcock & Wilcox Co., Alliance, Ohio.

Ralph A. Sherman, Assistant Director, Battelle Memorial Institute, and Director at large of the ASME, has received the 1948 Percy Nicholls Award for scientific achievement in the field of solid fuels. This is joint annual award of the Coal Division of the American Institute of Mining and Metallurgical Engineers and the Fuels Division of The American Society of Mechanical Engineers, and the presentation to Dr. Sherman was made at the Eleventh National Fuels Conference sponsored by these two divisions and held in November at White Sulphur Springs.

Anthony Skett has been named Technical Director, M. J. Merkin Paint Co., Inc., Lyndhurst, N. J. Mr. Skett was previously associated with W. R. Grace & Co., New York City.

Alfred E. Stacy, Jr., Director of Application Engineering, Carrier Corp., Syracuse, N. Y., has been elected 1949 President of the American Society of Heating and Ventilating Engineers.

Jesse W. Stillman, Head of the Analytical Division of the Chemical Dept. at the du Pont Experimental Station in Wilmington, Del., and Secretary of A.S.T.M. Committee E-3 on the Chemical Analysis of Metals, has been appointed a member of the Advisory Board of the journal, *Analytical Chemistry*, for a three-year term.

John D. Sullivan, Assistant Director of Battelle Institute, Columbus, Ohio, has been named chairman of a new division of the American Institute of Mining and Metallurgical Engineers, to be known as the Extractive Metallurgical Division, and organized to correlate metallurgical information on production and refining of non-ferrous metals. With the appointment, Dr. Sullivan, a nationally known metals authority, becomes one of the Directors of the AIME. **H. M. Shepard,** General Manager of the American Smelt-

ing and Refining Co., Baltimore, Md., will be Secretary of the Division.

George P. Swift, Consulting Engineer, Watertown, Mass., has been elected a Director of the American Institute of Mining and Metallurgical Engineers.

Edwin Ward Tillotson is the 1949 recipient of the Albert Victor Bleininger Memorial Award for distinguished achievement in the field of ceramics, presentation having been made recently by the Pittsburgh Section of the American Ceramic Society at a dinner at the Hotel Schenley. Mr. Tillotson, who is Assistant Director of the Mellon Institute of Industrial Research, has been active in A.S.T.M. Committee C-14 on Glass and Glass Products for many years, and is the present Chairman of that group.

A. J. Warner of the Federal Telecommunication Laboratories, Inc., and former Secretary of Committee D-20 on Plastics, has returned to the United States from England where he transferred last year. His new address with the Laboratories is 500 Washington Ave., Nutley 10, N. J. He is renewing his contacts with the Society.

Samuel B. Wilder has accepted a position with the Mastic Asphalt Corp., South Bend, Ind. He was formerly associated with the Great Lakes Carbon Corp. of the same city.

Jean R. Williams, formerly Senior Engineer, General Electric Co., Hanford Engineer Works, Richland, Wash., is now Asst. Professor, Civil Engineering Dept., University of Idaho, Moscow.

NECROLOGY

V. J. Altieri, Chief Chemist, Eastern Gas and Fuel Associates, Everett, Mass. (February 10, 1949). Member since 1934. While Mr. Altieri had been under treatment by his doctor, the heart condition which caused his death suddenly was not discovered until shortly before he died. His death came as a distinct shock to his many friends and associates, and his passing has removed from the Society ranks a most energetic and enthusiastic member. Chairman of the New England District Council, and a member of several A.S.T.M. technical committees, he had given unstintingly of his time and energy to the Society. An authority in the field of gaseous fuels, he had compiled a most extensive book on this subject, published a few years ago. It would be expected that he would be a member of A.S.T.M. Committee D-3 on Gaseous Fuels, and he also served as a consulting member of Committee D-5 on Coal and Coke, and on several subcommittees of D-16 on Industrial Aromatic Hydrocarbons. He was Vice-Chairman of the last-named committee, and Chairman of its Committee on Methods of Test for Refined Aromatic Products. To Mrs. Altieri and their three children, and to his business associates and friends, the Society extends its sympathy. In Mr. Altieri's death A.S.T.M. has indeed lost a loyal and very active member.

J. R. Becker, Materials & Process Engineering Dept., Westinghouse Electric Corp., East Pittsburgh, Pa. (February 3, 1949). Representative of his company since 1928 on Committee B-1 on Wires for Electrical Conductors, and Committee D-11 on Rubber and Rubber-like Materials.

C. W. Bryden, DeLaval Separator Co., Poughkeepsie, N. Y. (January 11, 1949). Representative of his company since 1947 on Technical Committee K on Cutting Fluids of Committee D-2 on Petroleum Products and Lubricants.

Alfred R. Ebberts, Assistant Asphalt Testing Engineer, California Division of Highways, Sacramento, Calif. (January 2, 1949). Member since 1930.

Warrick Rigeley Edwards, retired in 1938 from Baltimore & Ohio Railroad, Baltimore, Md. (January 12, 1949). Member since 1902.

Lewis M. Elphinstone, President, D. C. Elphinstone, Inc., Baltimore, Md. (July 29, 1948). Member since 1941.

John L. Foulke, Chief Chemist, A. & M. Karagheusian, Inc., Freehold, N. J. (January, 1949). Representative of Company Membership since 1946, and representative of his company since 1943 on Committee D-13 on Textile Materials where he rendered service on many subcommittees.

W. R. Guy, Senior Chemist in Charge of Central Lab., Scottish Oils, Ltd., Uphall, West Lothian, Scotland. Member since 1937.

J. M. Lurie, Rogers Corp., Goodyear, Conn. (January 1, 1949). Representative of Company Membership since 1947.

Charles A. Marlies, Associate Professor of Chemical Engineering, College of the City of New York, New York City (January 13, 1949). Member since 1932 (Life Member). A graduate of the College of the City of New York, and of Columbia, where he obtained his degree of Ph.D., Dr. Marlies had been on the faculty of City College since 1928. He was interested in the work of numerous societies and was an officer of several New York chapters. In A.S.T.M. he served on a number of technical committees and at the time of his sudden and untimely death he was a member of Committee B-8 on Electrodeposited Metallic Coatings, D-12 on Soaps and Other Detergents, D-14 on Adhesives, and E-8 on Nomenclature. Dr. Marlies was keenly interested in having his students acquainted with A.S.T.M. work and he believed that many of the A.S.T.M. publications would be of real service in his teaching activities. Down through the years there have been a goodly number of Student Members in A.S.T.M. from City College of New York, and many of them procured special parts of the Book of Standards and other A.S.T.M. books through their Student Membership for certain of their courses. Elsewhere in this issue is a review of a new textbook prepared by Dr. Marlies and an associate.

Marion S. Mayo, Textile Engineer, Los Angeles, Calif. (January, 1949). Member since 1944. Member of Committee D-13 on Textile Materials since 1944, also member of the Southern California District Council.

Ralph W. E. Moore, Electricl Engineer, National Electric Products Corp., New York City (December 20, 1948).

Representative of the National Electric Products Corp. in its A.S.T.M. Sustaining Membership. At the time of death Mr. Moore was serving on several A.S.T.M. technical committees, notably on A-5 on Corrosion of Iron and Steel, and B-1 on Wires for Electrical Conductors. He also served on Committee D-11 on Rubber and Rubber-like Materials and D-20 on Plastics.

ANDERSON POLK, Retired Engineer, Rosemont, Philadelphia, Pa. (January 7, 1949). While the name of Anderson Polk has not appeared in the Society records for a great many years (Member 1902–1920) and he would be known to only some of the long-time members, it is appropriate to record his passing in January of this year, at the age of 79. For many annual meetings during the very early years of the Society, Mr. Polk was in charge of the ladies' entertainment and program at the meetings, and many interesting affairs were held under his planning.

J. F. SEILER, Chief Engineer, Service Bureau, American Wood Preservers' Assn., Chicago, Ill. (January 16, 1949). Member since 1933, and member of Committee D-7 on Wood since 1934.

ARCHIBALD D. SHANKLAND, Assistant General Manager, Bethlehem Steel Co., Inc., Bethlehem, Pa. (January 5, 1949), A key man in the Bethlehem Plant for many years, and a member of A.S.T.M. since 1934.

HAROLD H. SIEGEL, Metallurgist, Howard Foundry, Chicago, Ill. (October 29, 1948). Member since 1947, and member of Committee B-7 on Light Metals and Alloys.

SANFORD E. THOMPSON, President, The Thompson & Lichtner Co., Boston, Mass. (February 25, 1949). Member since 1904. In the death of Mr. Thompson the Society loses one of its long-time members who particularly in the early years rendered notable service to the Society and who all his life had been greatly interested in A.S.T.M. activities. The fact that Committee C-9 on Concrete and Concrete Aggregates, of which he was the first Chairman, from 1914 through 1922, and on which he retained membership continuously, named its annual award in his honor, and elected him to honorary membership in that group in 1947, indicates the respect in which he was held by that committee. He served for many years on Committee D-4 on Road and Paving Materials, and his membership or that of his associates has been continuous on C-1 on Cement since 1919. A graduate of Massachusetts Institute of Technology in 1889, Mr. Thompson in 1905 established The Thompson & Lichtner Co.

In his passing the Society has lost a most loyal and conscientious member who down through the years rendered notable service in advancing important aspects of the Society's work. To his family and associates A.S.T.M. extends sincere sympathy.

HENRY B. TILTON, Director, The Morley Co., Portsmouth, N. H. (March 4, 1948). Member since 1912.

CHARLES G. WEBER, Paper Technologist, National Bureau of Standards, Washington, D. C. (January 18, 1949). Member since 1948. Representative of National Bureau of Standards for many years on Committee D-6 on Paper and Paper Products, and Committee D-10 on Shipping Containers. Mr. Weber died very suddenly from a heart attack while engaged in his work at the Bureau. His loss will be keenly felt, particularly in Committee D-6 where he had worked intensively. A member of the Advisory Group, he was on several subcommittees and Chairman of Subcommittee I on Paper Testing Methods, in which field he was an acknowledged authority.

Notes on Laboratory Supplies

Catalogs and Literature; Notes on New or Improved Apparatus

This information is based on literature and statements from apparatus manufacturers and laboratory supply houses.

Catalogs and Literature

W. C. Dillon & Co., Inc., 5410 W. Harrison St., Chicago 44, Ill. A 16-page booklet entitled "Model K Dillon Universal Tester" describes this machine in detail. Illustrates Universal Testers of different heights with different jaw openings for different testing purposes, interchangeable dynamometers for changing capacities, etc. It tests standard specimens and special specimens, is easy to motorize, and is set up in a sturdy steel stand for proper eye level. Specimen charts are included in the back of the catalog.

Leeds & Northrup Co., 4934 Stenton Ave., Philadelphia 44, Pa. Leeds & Northrup's complete line of Speedomax instruments, indicators, indicating recorders, and recording controllers, is described and illustrated for the first time in a new 44-page catalog. Called "Speedomax Type G Instruments" the publication describes these high-speed, high-sensitivity instruments for all the uses for which they are now available. The pyrometers listed are supplied for measuring temperature with thermocouples, Rayotubes or Thermohms; other Speedomax instruments listed are those for recording speed and load; the recording controllers are offered for two-position control or are integral parts of full proportional control systems—either Speedomax Electric Control, Position-Adjusting Type for regulating valves, vanes or dampers; Duration-Adjusting Type, primarily for electrically heated units—Speedomax Pneumatic Control, a new and advanced system for air-actuated valves. Illustrated. Catalog ND46(1).

Carl Schleicher & Schuell Co., 116-118 W. 14th St., New York 11, N. Y. Catalog No. 70 entitled "High Quality American Filter Papers" contains sections on relative values of retention of S&S analytical filter papers, in form of diagram; selection of the most suitable grade of S&S analytical filter paper; physical characteristics of S&S filter papers for laboratory use; detailed index of S&S analytical filter papers and accessories; products for laboratory use; S&S reference tables for filtrations in methods of inorganic chemical analysis; etc. Illustrated. 36 pages.

The Gaertner Scientific Corp., 1201 Wrightwood Ave., Chicago 14, Ill. Bul-

To the A.S.T.M. Committee on Membership, 1916 Race St., Philadelphia 3, Pa.

Gentlemen:

Please send information on membership to the company or individual indicated below.

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This company (or individual) interested in the following subjects: (indicate field of activity, that is, petroleum, steel, non-ferrous, etc.,)

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Signed ________________

Date________________ Address________________

letin 161-48 entitled "Gaertner Measuring Microscopes for Laboratory and Shop" describes and illustrates micrometer microscopes, traveling microscopes, micrometer slide comparators, instruments for measuring creep, thermal expansion, etc., and many different accessories and related equipment. An introductory section contains much information on the selection and use of measuring microscopes, their construction, optical principles, and method of calibration. Illustrated. 24 pages.

Scientific Glass Apparatus Co., Inc., 49 Ackerman St., Bloomfield, N. J. A 16-page folder "What's New for the Laboratory" describes over a dozen new items of interest to scientific personnel. Some of these are porcelain tiles, three-dimensional laboratory support, pipette washer, pressure regulator, solution dispenser, adjustable clamp, microscope, and others. Illustrated.

Burrell Technical Supply Co., 1942 Fifth Ave., Pittsburgh 19, Pa. A four-page folder "Burrell Combustion Tubes and Boats" Bulletin No. 214, describes McDanel Combustion Tubes Fired for High-Temperature Furnaces and Zircum High-Temperature Combustion Tubes. Illustrated.

Jarrell-Ash Co., 165 Newbury St., Boston 16, Mass. Jaco Catalog No. I-4 entitled "Spectrographic Equipment for Research in Spectroscopy and for Spectrochemical Analysis in Metallurgy, Mineralogy, Agronomy, Chemistry, Medicine, and Other Fields" describes the Fully Automatic Large Grating Spectrograph, Adjustable Grating Spectrograph parts for the Spectrograph, Accessory Equipment for the Spectrograph, the Projection Comparator Microphotometer, Galvanascope, N.S.L. Spec-Power, etc. Illustrated. 20 pages.

Meyer Scientific Supply Co., Inc., 221 Atlantic Ave., Brooklyn 2, N. Y. A four-page folder describing Stainless Steel Analytical Weights, Glas-Col Electric Heating Mantles and Accessories, Powerstat Transformers, Beckmann pH Meter Model H-2, Ohaus Triple Beam Balance with Stainless Steel Beams and Platform, etc. Illustrated.

E. H. Sargent & Co., 155–165 E. Superior St., Chicago 11, Ill. The Winter edition of Scientific Apparatus and Methods" (Including Latest Catalog Revisions) covers Phase Microscopy, Analysis with a Mercury Cathode, Determination of Oil Content, and Polarography of Lead. Section 2 of this booklet covers Scientific Apparatus—new items, reinstated items, discontinued items, and changes in specifications. Illustrated.

Will Corp., Rochester, N. Y. Laboratory Equipment Bulletin, No. 106, describes features of the new Spencer "Scholar's" Microscope created specifically for science teaching. Correctly controlled illumination is easily achieved with the built-in illuminator which eliminates the variables found in the use of daylight. Also described in this folder is a new stainless steel water bath with double temperature setting for control at 37.5 C. and 56 C. Barnstead water stills and demineralizer are also discussed. Four pages, illustrated.

Instrument Notes

Laboratory Day-Night Clock Switch—Fisher Scientific Co., 717 Forbes St., Pittsburgh 19, Pa. Provides a control device by means of which the laboratorian can pre-set electrical equipment to be turned on or off as long as a week after the switch has been set. It enables the user to pre-set the clock so that a laboratory furnace, oven, or other equipment requiring long warmup time will be turned on automatically at 6 a.m. the next morning. The new Clock Switch operates on 110 volts, 60 cycle a. c., and will control equipment up to 1500 watts current. Two indicators on the 24-hr. dial are moved in setting the mechanism for the desired "turn-on" and "turn-off" periods. A calendar wheel adjustment permits setting the mechanism to repeat the same on-off cycle each day—or to skip any day of the week.

New Immersion-Type Micro-Set Thermoregulator—Fisher Scientific Co. This Thermoregulator is for laboratory use in controlling liquid temperatures, in water and oil baths, or air temperature in ovens, etc., has a sensitivity of ±0.02 F. over a range of 50 to 220 F. Only 15 in. long, its patented design eliminates an outer shell so that there is a minimum of lag in response to slight temperature changes. The Thermoregulator features a quick-adjustment sleeve which magnetically moves one of two electrodes so that the regulator will turn heating devices on and off to maintain any temperature within its range. The device is for operation with relays such as the Fisher-Serfass Electronic Relay.

Stainless Steel Containers—The Emil Greiner Co., 20–26 N. Moore St., New York 13, N. Y. These containers incorporating the latest advances in high vacuum insulation are absolutely unbreakable, effect saving of time in filling, cleaning, and sterilizing. Sizes range from 11 gal. to the one-quarter capacity. Each container has double-walled insulation.

AB Wet Power Grinder—Buehler Ltd., 165 W. Wacker Drive, Chicago 1, Ill. This is a general purpose grinder which may be used in the shop or the tool room for dressing, touch up or the rough flat form grinding of standard tools or small parts by hand. It carries two wheels which may be had in a variety of grits, and it is available for either bench or floor mounting. Its major advantages are speed of obtaining the desired size or shape; quality of the grind easily maintained; safety in operation.

Farrand Electron Multiplier Photometer—Farrand Optical Co., Inc., 4401 Bronx Blvd., New York 66, N. Y. This Photometer has a selective wide range of sensitivity, linear response, measurements in the ultraviolet and visible region, dark current balance control, constant voltage, stable battery power supply, flexible utility, is compact and simple to operate. It has been designed for general purpose measurement of very low light intensities. By choice of a photomultiplier having optimum characteristics in the ultraviolet or visible region of the spectrum, the use of the photometer is readily extended to numerous and broad applications concerned with photometry. It is comprised of three units: detector, power supply and controls, and galvanometer.

Flex and Fold Testing Instrument—Custom Scientific Instruments, Inc., P. O. Box 170, Arlington, N. J. This instrument is designed to test the resistance of various flexible materials, such as textiles, coated fabrics, plastics, etc., to flexing and folding. The instrument accommodates four samples, approximately 3 in. by 7 in. Three of these samples may be flexed simultaneously and one sample folded. Essentially, the flexing operation consists of holding the sample to be tested under a constant tension and moving one end of the sample through a given distance each side of the perpendicular. This action throws stresses and strains into the sample which will cause the material to break down. The number of flexes which a material should withstand before a breakdown would, of course, be determined by the purpose for which the material is to be used.

New Stabiline Voltage Regulator—Superior Electric Co., Bristol, Conn. Among the features of this new portable Stabiline Voltage Regulator is its completely electronic operation, involving the use of no moving parts. It is said to deliver a constant output voltage regardless of variations in input voltage or load current. Standardization of tubes is one of the innovations said to be found in this portable voltage regulator. The unit is self-contained in its cabinet; is complete with 6-ft. cord-plug, two output receptacles and a pair of Superior Electric five-way binding posts. The fuses are located at the input for convenience; an "on-off" switch, pilot light and screwdriver adjustment for output voltage completes the unit's controls.

Photoelectric Colorimeter, Type Hedin—Transeno Aktiebolag, Kungsgatan 65, Stockholm, Sweden. Especially designed for rapid analysis of silicate materials, this colorimeter consists of two identical compartments. The measurements can therefore be made either with the aid of a calibration curve or direct by means of a reference (comparison) solution. The source of light is a mercury discharge lamp which is directly connected to the 220-v., a-c. supply. The lens directs the rays into a parallel beam, which passes through a glass cell filled with water. This cell absorbs and dissipates the heat transmitted by conduction and radiation. The last remainder of radiant heat is absorbed by the heat filter, placed in the glass cell. After cooling, the light is rendered monochromatic by a series of glass filters inserted in removable holders so that the whole filter set can be replaced at one time. The colorimeter is always ready for immediate use and the idle time is reduced to a minimum, due to the circumstance that the thermal equilibrium does not need to be disturbed and the filters do not need to be deranged.

New Variac Continuously Adjustable Transformers—General Radio Co., Cambridge 39, Mass. Several different Variacs are described in General Radio's eight-page folder including Type 200-B, Type V-5, Type V-10, V-20, and Type 50. The Variac is the original continuously adjustable auto-transformer; it consists of a single copper winding on a toroidally shaped iron core. Contact between the winding and the load circuit is made through a special carbon brush which contacts at least one turn of wire at all times; output voltages from the Variac are continuously variable with perfect smoothness from zero to 17 per cent above line voltage.

AB Duo-Belt Surfacer—**Buehler Ltd.** Offered as a further advantage to the metallographer in the wet preparation of specimens, this Surfacer follows the grinding sequence from very coarse to very fine. The special belts may be used wet or dry, and are available in grits from 80 to 600. A ½-hp. motor with two speeds drives both belts at either 1600 or 3200 feet per minute. The grinding area is open at both sides so that specimens may extend over the edges of the belt in either direction. Header jets provide uniform distribution of the coolant over the entire work area of the belt. The machine is designed for bench mounting and external water and waste connections may be used.

Two New Tate-Emery Air Cells—**The Baldwin Locomotive Works,** Philadelphia 42, Pa. These two air cells have load ranges of 0–1.2 to 0–6 lb. and 0–2 to 0–10 lb. in tension and compression. They were designed for use on testing machines of any type or capacity to give high precision measurement of small loads such as in testing plastics, textiles, cord, paper, and other material. They can also be used independently for such purposes as weighing chemicals, or controlling chemical processes. When a standard Tate-Emery Indicator with 66-in. scale is connected with the cell, the 0–2 lb. range shows a pointer movement of approximately 2 in. for one ounce or $\frac{1}{16}$ in. for one gram. An air jet and baffle within the cell controls the action of a pneumatic force balance system, so that air pressure automatically balances the load. Total movement of the load-sensitive member is less than 0.0005 in. This air pressure is transmitted to the load indicator.

New Hydraulic Weighing Cell—**Baldwin.** A new type of Emery hydraulic cell, designed for measuring tension loads as conveniently as compression. Capacities of three cells in compression are 20,000, 40,000, and 60,000 lb. Maximum tension loads of half of these capacities may be applied on a removable eyebolt screwed into the inside end of the piston, which is made accessible through the closed end of the cell. The cells may be used in any position. The Emery cell may be considered a hydraulic cylinder with a frictionless piston having a stroke of less than 0.005 in. under full load.

Model 10VA Testing Machine—**All American Tool & Mfg. Co.,** 1014 W. Fullerton Ave., Chicago 14, Ill. Electronic aircraft, automotive, and other parts, components and assemblies up to 10 lb. in weight can be readily subjected to vibration fatigue tests on this machine. Parts to be subjected to tests are secured to table which has 48 conveniently spaced, drilled, and tapped holes. Work table is supported at four points to overcome stresses from parts that necessarily overhand table. Vibration in simple harmonic motion is produced vertically. Acceleration is changed automatically and continuously and is recorded on a tachometer. Structural weak points are readily divulged by tests on this machine, which also points the way to reduction of excessively heavy metal sections.

The HRX-Hilger Research X-Ray Diffraction Unit—**Hilger & Watts, Ltd.,** London, England. The unit employs a continuously pumped Coolidge type tube with a hot filament. The target consists of a large cone opposed by four separate filament coils, one for each window. By rotating the cone a small amount a fresh target surface can be exposed to the X-ray beam. Because of this it is possible to operate the tube at current densities considerably greater than those for sealed tubes. Three or even four different radiations can be obtained from the same tube simultaneously. These radiations can be changed independently at each of the four windows. The X-ray tube itself will last a lifetime. Targets and filament assemblies can be readily replaced at very small cost.

News of Instrument Companies and Personnel

Steel City Testing Machines, Inc., Detroit, Mich., manufacturer of machines for the physical testing of metals, announces the appointment of two exclusive sales representatives. This is part of a wide, long-range company program to have qualified field representatives in all important industrial centers of the nation. J. W. Dice & Co., Grand View-on-Hudson, N. Y., has been appointed to cover the middle Atlantic Area. Steel City Tool and Machinery Co., Inc., Pittsburgh, Pa., has the Pittsburgh area including Western Pennsylvania, West Virginia, and adjacent counties in Ohio. Steel City Testing Machines, Inc., has been manufacturing Universal, Brinell, Ductility, Compression, Transverse, Tensile, Hydrostatic, and Special Testing Machines, and Proving Instruments, for over 35 years.

Sam Tour & Co., Inc., consulting engineers, 44 Trinity Place, New York 6, N. Y., announces the reorganization of their Mechanical Engineering Department under the supervision of John J. Meadows, P.E., who has just joined the organization.

Principles of High-Polymer Theory and Practice

This textbook, which is another in the Chemical Engineering series, consists of 16 sections. The first ten sections cover the structure, intermolecular forces, special properties, solubility, and molecular weight, rheology and electrical thermal and optical properties. These principles are then applied to plastics, rubbers, fibres, coating, and adhesives in the last six sections.

Each section has its own references and the appendix contains a guide to high-polymer literature. It also contains a listing of the properties of fibres, plastics, and rubbers, and gives data on the adhesion, compatibility, and solubility of high polymers.

The book is well written and the authors, A. X. Schmidt and Chas. A. Marlies, have brought together the information on the chemistry and physics of high polymers. They have gathered in one book information on plastics, rubbers, fibres, adhesives, and coatings and show that all these materials have the principles of high polymers in common. The information is factual and is presented with a minimum of errors.

The book should be of much use especially to chemists and chemical engineers who are interested in plastics, rubbers, or fibres.

Copies of this 743-page publication can be obtained from the publishers, the McGraw-Hill Book Co., New York, N. Y., at $7.50.

F. J. Wehmer

Note from the Editor: We are very sorry indeed to report the sudden death of Prof. Charles A. Marlies, co-author of this publication. He had taken an active and constructive interest in A.S.T.M. work. See the Necrology section for further details.

Errata—Papers on Adhesive Properties of High Polymers and on Rating Rusted Steel

In the paper by Charles J. Seiler and A. D. McLaren "Theories of Adhesion as Applied to the Adhesive Properties of High Polymers," published in the ASTM Bulletin, No. 155, December, 1948, page 50, a reference number 26 was added at the end of the summary but the reference itself was not given. Reference 26 should read as follows:

(26) A. D. McLaren, "Adhesion of High Polymers to Cellulose. Influence of Structure, Polarity and Tack Temperature," *Journal of Polymer Science*, Vol. 3, p. 652 (1949).

In preparing the October ASTM Bulletin for press, the type used in connection with Fig. 1 of the paper by H. L. Faigen, "A Visual Rating System for Rusted Steel Specimens," became misaligned. For Numerical Rating 10, there should be no listings under the column headings "Rust Spots" and "Small Rust Areas." The first two listings under each of these headings should have been dropped one space to align with ratings 9 and 7. The table on the lower right-hand corner of page 40 summarizes the ratings and their corresponding descriptions clearly.

A History of Hardness Tests Based on Scratch Resistance Measurements[1]

By Ernest C. Bernhardt[2]

Scratch tests were first made in attempts to use them as gages for hardness of materials. All the methods of hardness testing are based on the principle that hardness is the relative resistance which a body offers toward penetration (**3**).[3] The difference between penetration along a surface (scratch) and penetration into a material (indentation), however, was not recognized in the early tests.

One of the first scratch tests recorded in the literature is that of Fr. A. Barba in 1640 who wrote: "Hardness is such a property of precious stones that those which a file can scratch are not so classed" (**9**).

By 1722 Reaumur had devised a scale of seven standard materials for the scratch grading of hard materials (**14**). Werner in 1774 and Hauy in 1801 both devised similar scales for scratch methods of their own (**3**), before the introduction of the hardness scale for minerals by Friedrich Mohs in 1822 (**9**). The scale of hardness which Mohs established is still the recognized scale for mineralogical hardness, and has found some application by metallurgists. By scratching them with each other, he placed his minerals in a series divided into ten degrees of increasing hardness from talc—which he considered softest—to diamond, the hardest.

Another scale of metallurgical standards of hardness consisting of 18 specimens ranging from lead to glass-hard steel had been developed by the Prague Technical College in 1882 for scratch testing of metallurgical samples (**9**).

Huyghens as early as 1690 was the first one to note directional hardness effects when he scraped Iceland spar with a knife blade (**4**). In 1829 Frankenheim detected directional differences in hardness by using metal needles to produce a scratch and judging the relative degree of hardness by the pressure and pull necessary to produce a scratch (**4**).

In order to measure these forces, Seebeck in 1833 built a scratching instrument carrying a permanent hard tool on which rested a weight. This instrument was pulled over the sample being tested, thus producing a scratch. After Grailich and Pekarek in 1854 improved Seebeck's machine, it became known as a "Sclerometer" (**9**).

A great variety of sclerometers have been built since then. These instruments can be divided into three main groups according to the effects measured by them:

Measurement of Weight Necessary to Produce a Scratch of Given Dimensions:

One may find the minimum weight necessary to produce a scratch visible under certain conditions of illumination as was done by Franz (1850), Seebeck, Grailich, and Pekarek (1854) (**7**), Exner (1873), Turner (1887), Jannettaz (1893), Keep (1899), and Parsons (1910) (**9**). The instrument used by Franz in his work is shown in Fig. 1.

A variation of this type of test was employed by Huygueny in 1865, when he determined the load on a Glazier's diamond necessary to give a scratch of standard width (**4**). Similarly, Turner in 1907 and Koch in 1908 determined the weight needed on a diamond needle to produce scratches of a given width. Martens in 1890 measured the weight necessary to produce a scratch of 0.01 mm. width with a 90-deg. diamond cone (**9**).

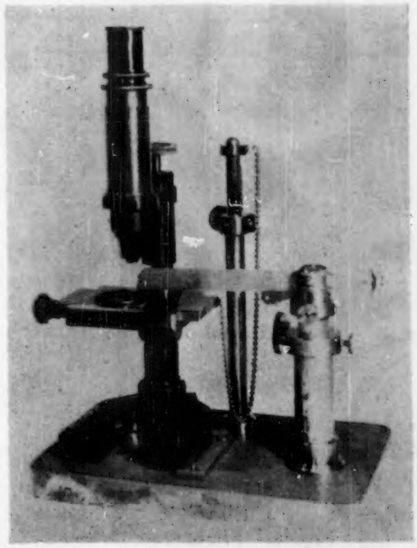

Fig. 2.—An Interpretation of the Graton Sclerometer as Built for the Physics Laboratory of Amherst College.

O'Neill (1928) devised a precision instrument to study directional hardness in single metallic crystals. Using a hemispherical diamond, he varied the load, and determined the load needed to produce a scratch having a standard width. Then he expressed hardness as $H = 8W/\pi d^2$ (**9**).

A more recent instrument used to measure hardness in terms of load necessary to give a constant width of scratch is the Graton sclerometer (1925). A recent design of this instrument is shown in Fig. 2, while an earlier model is illustrated in Fig. 3 (**14**).

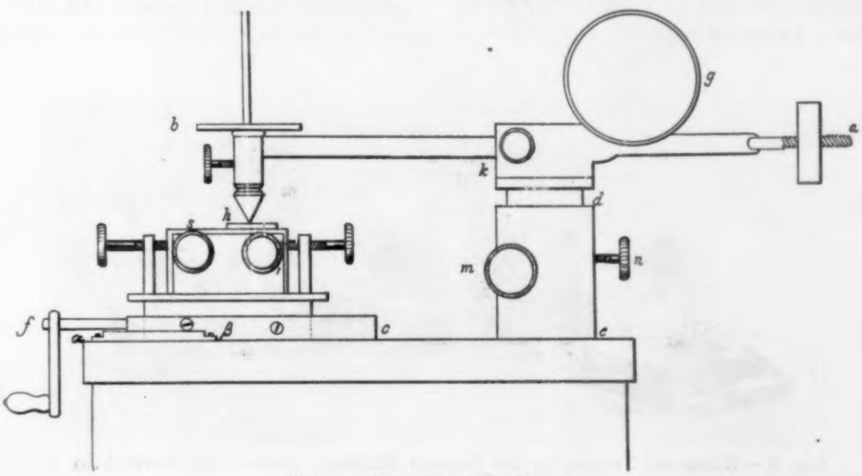

Fig. 1.—Instrument by Franz.

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

[1] This paper presents a history of various scratch methods which have been devised as tests for hardness, compiled as a preliminary survey in a study of the scratch resistance of plastics. (E. C. Bernhardt, "Scratch Resistance of Plastics," *Modern Plastics*, October, 1948). In view of its general interest, this paper is published in the A.S.T.M. Bulletin.

[2] Research Fellow in Chemical Engineering, University of Delaware, Newark, Del. Present address: Plastics Division, Monsanto Chemical Co., Springfield, Mass.

[3] The boldface numbers in parentheses refer to the list of references appended to this paper.

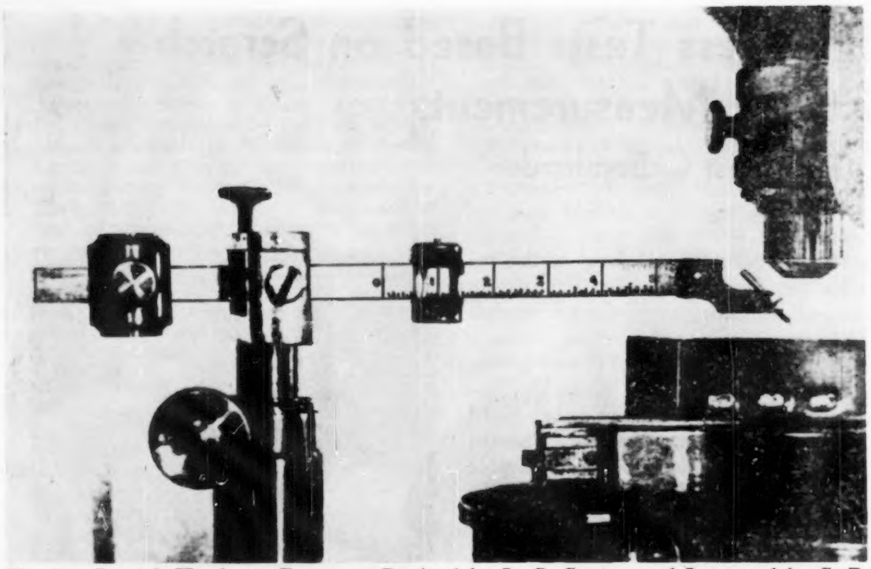

Fig. 3.—Scratch Hardness Tester as Devised by L. C. Graton and Improved by S. B. Talmage.

Determination of Width of Scratch for a Given Load on the Scratching Tool:

This type of test was employed by Martens in 1890 using the instrument shown in Fig. 4. Slight modifications were made by J. Hirschwald to result in the apparatus shown in Fig. 5 (**14**). This instrument is widely employed abroad and has become a standard testing apparatus. Weights of 20 g. or 40 g. can be applied to the 90-deg. diamond cone, and hardness is calculated according to the formula $H = 1/W$. Since the measurement of the width of scratch has to be obtained with great accuracy, W. H. Newman (**8**) proposed to make a wax impression of the scratch, and to project it to seventy times its size upon a screen. The width of scratch might then be measured from the projection with increased accuracy.

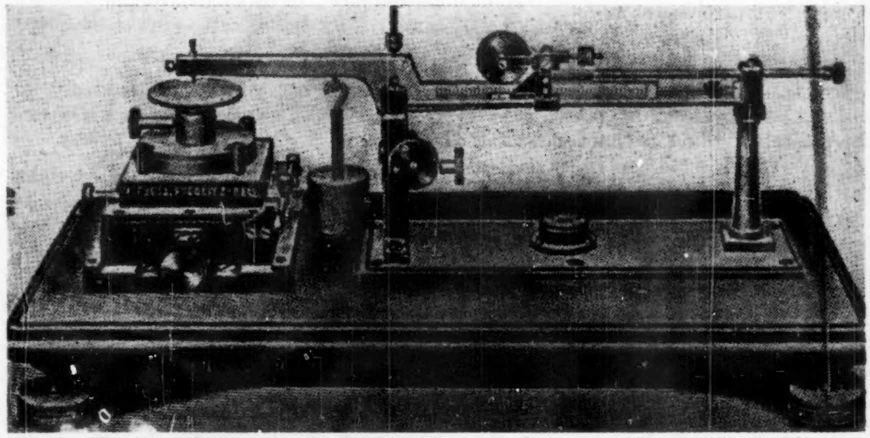

Fig. 4.—Hardness Testing by the Scratch Method. Instrument Devised by A. Martens.

Further investigations were carried out by Pöschl (**10**) in 1909 who determined the change in width of scratch for varying loads on the needle. Mounting his sclerometer together with a microscope, he was able to determine the width of scratch with an accuracy of 2 microns. An octahedral diamond served as the scratching tool (Fig. 6).

In 1919 Hadfield and Main measured the width of scratch produced by a pyramidal diamond under a 6-oz. load, and expressed the hardness according to the formula $H = W/d^3$ (**9**). Another instrument working on the same principle was built by Desch in 1920.

The standard scratch instrument most widely used in America was developed by C. H. Bierbaum (**1**) in 1920, and is known as the microcharacter (Figs. 7 and 8). It is a sclerometer built on the stage of a measuring microscope. A diamond, held in an elastic support, and having the form of the corner of a cube is used as the scratching tool. This diamond is said to have a perfectly sharp point as viewed under 2000 magnifications. A standard load of 3 g. on the diamond is employed, and the width of scratch is measured through the microscope with a micrometer eyepiece. Microhardness is expressed according to the formula $H = 10^4/d^2$ (d in microns). The microcharacter is a precision instrument, manufactured to exacting specifications, and is recognized in industry as a standard testing instrument.

It should be noted that the scratch is made at such a low speed that when the motion of the tool over the specimen is stopped, no further indentation occurs. This makes the Bierbaum test principally an indentation rather than a scratch test.

Other instruments measuring the width of scratch produced by a tool under a standard load which were developed later than the microcharacter but did not come into general use include an instrument by Hankins (**14**) in 1923, using a V-section diamond (Fig. 9). Hankins expressed hardness in the formula $H = W/d^2$. Shires (**9**) (1925) measured the width of scratch produced with a standard load on a Glazier's diamond.

In 1937 the Diritest (Zeiss) scratch instrument operating under a controlled constant speed was described by Sporkert (**12**). Preliminary tests had

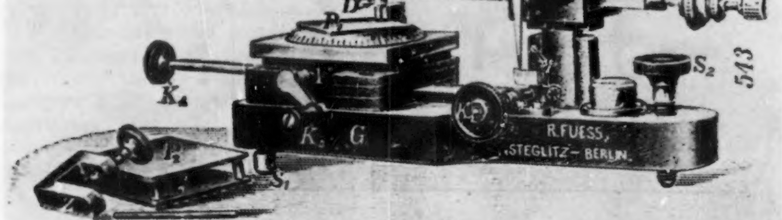

Fig. 5.—Hardness Testing by the Scratch Method. Instrument Devised by J. Hirschwald.

Fig. 6.—Combination Sclerometer and Microscope by Pöschl.

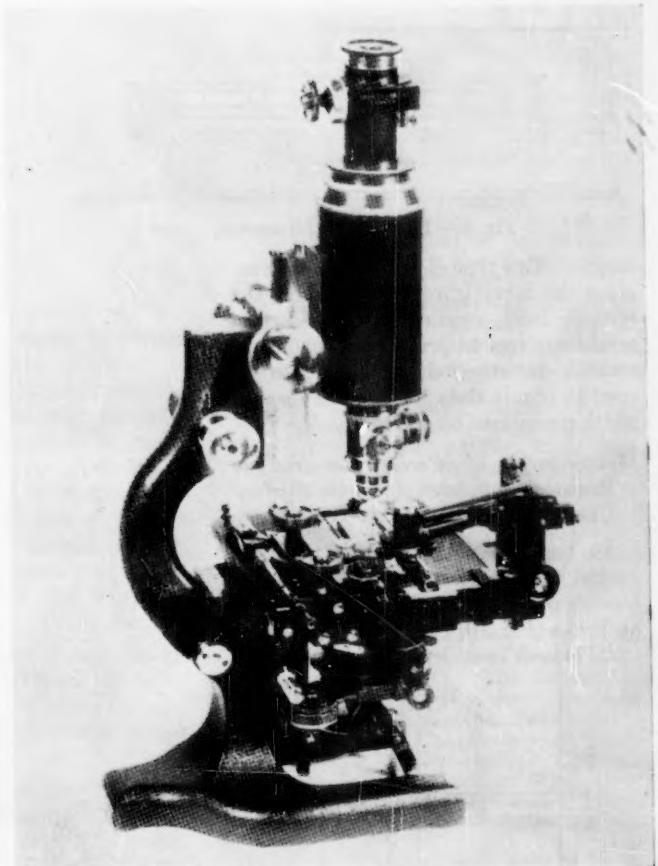

Fig. 7.—The "Microcharacter" and Measuring Microscope with Micrometer Eyepiece

revealed that results of various scratch hardness tests were dependent on speed of scratch. For this reason a synchronous motor was used to replace the hand crank previously employed in tests of this type to move the sample along under the needle. A diamond cone of 120 deg. served as the scratching tool, and the width of scratch for various loads and various speeds could be obtained.

Starkie (**13**) (1942) described a scratch test employed to measure the surface hardness of plastic materials. In this test a pyramidal diamond point was dragged under a 2-kg. load over the surface of the specimen. The hardness value of the material under test was taken as the reciprocal of the width of the scratch in centimeters for this standard load.

Finally, one other type of scratch testing device might be classified with this group. This is the so-called scratch dynamometer developed at the Eastman Kodak Laboratories in 1932 for evaluation of surface hardness of cellulose derivatives (**11**). On this apparatus the specimen is scratched at a uniform speed by a tool under steadily increasing load. The load at any point along the scratch is known. Measurements of the scratch width can be taken all along its

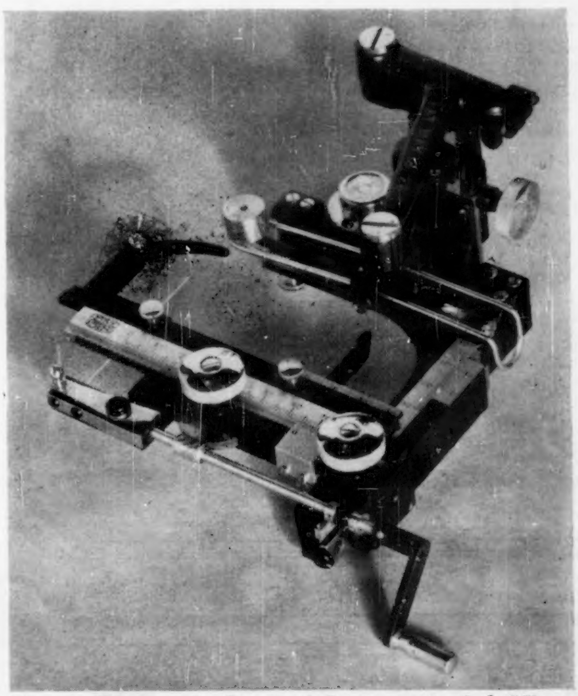

Fig. 8.—Bierbaum's Standard Instrument, the Microcharacter. Unattached to Any Stand.

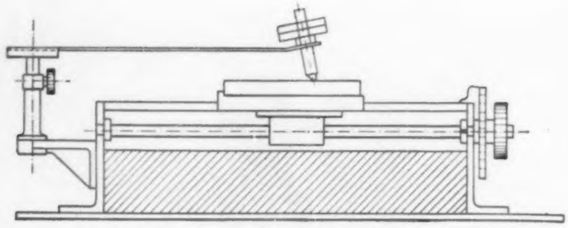

Fig. 9.—Hankin's Sclerometer.

length. This type of test instrument enables the investigator to determine the critical load required on a certain scratching tool to produce a permanent scratch deformation. It can also be used to obtain data for plots of scratch width *versus* load on the tool.

Measurement of Forces Required to Propagate a Scratch Along the Surface Under a Fixed Load on the Tool:

An instrument to measure the tangential force required to pull a loaded scratch point was built as early as 1850 by Franz (Fig. 10) (4). In 1854 Grailich and Pekarek considered hardness as the reciprocal of the force required to move a specimen horizontally under a scratching tool weighted by a standard load.

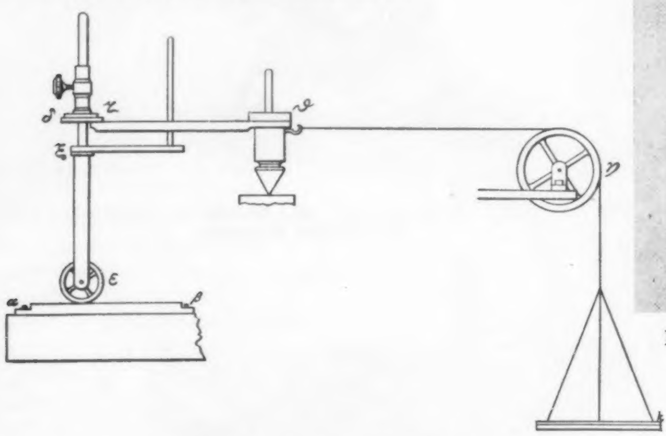

Fig. 10.—Instrument by Franz.

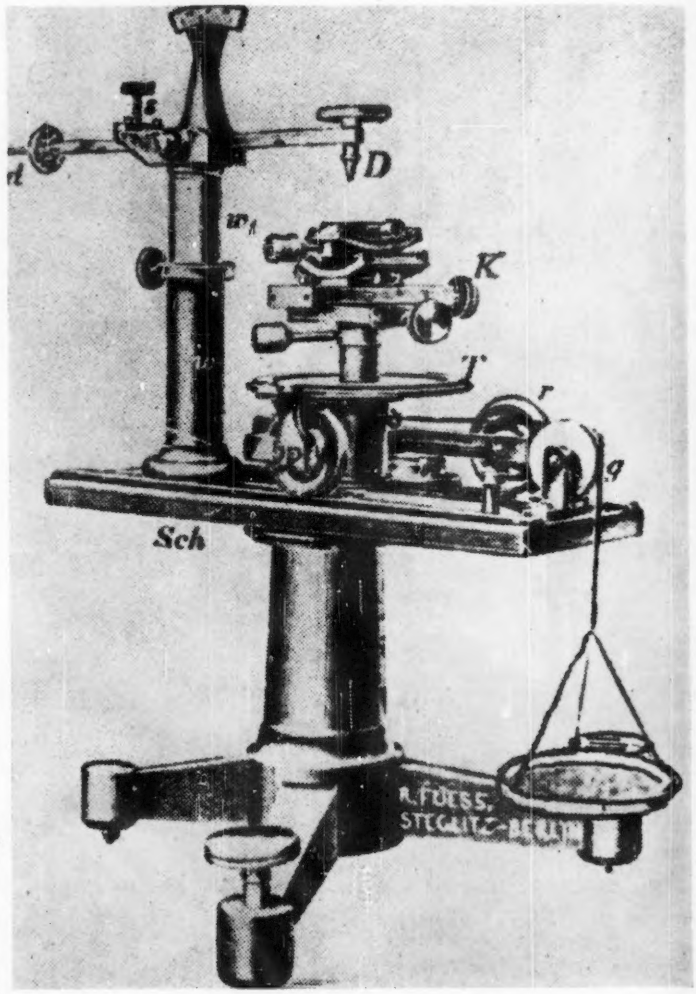

Fig. 12.—A Scratch Hardness Tester with a Centering Head for Holding the Specimen.

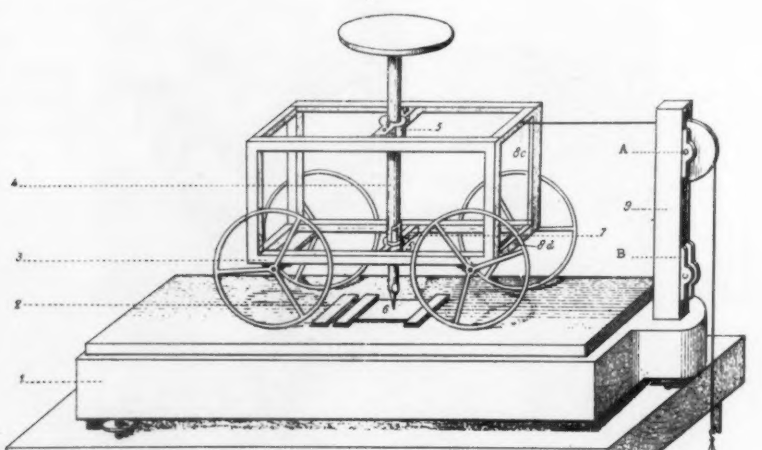

Fig. 11.—Instrument by Hugueny.

A clear differentiation between hardness normal to a body and tangential hardness or scratch hardness was made by Hugueny in 1865 (4). Figure 11 shows the apparatus which he employed for his determination of the force required to produce scratches with given weights on the needle. Similar measurements were made with a variation of the instrument by Martens (Fig. 12), and investigations along the same line by Pöschl (10) in 1909 were conducted using the apparatus shown in Fig. 6.

In 1907, Kip (5, 6) proposed to gage hardness of minerals by the resultant of the normal and tangential forces necessary to scratch the specimen permanently. The normal force was chosen just great enough to produce a permanent scratch on the sample, and the tangential force was then determined with the apparatus shown on the schematic

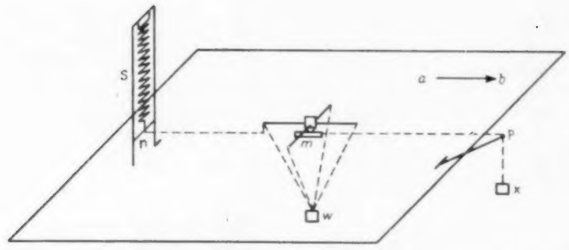

Fig. 13.—Schematic Diagram of Instrument Proposed by Kip.

diagram in Fig. 13. The diamond resting on the surface of the mineral m is balanced by a weight w hanging directly beneath it, and suspended from four arms running from the center into which the diamond is fastened. Pressure on the point is regulated by the size of weight w. The mineral m is drawn in direction ab by means of a thread passing over a pulley to weight x. A thread attached to one of the arms runs in direction ba through a pulley at n to a vertical spring balance s. As the mineral is now drawn in direction ab, the diamond point rides with it until the tension in s is sufficient to cause it to scratch. The critical tension in s is determined accurately. Kip then expresses the hardness as $H = \sqrt{s^2+w^2}$.

With the more extensive use of plastic materials, the testing of scratch resistance has become a matter of great importance in the plastics industry. Since plastics have relatively low scratch resistance, this property may often be a crucial factor limiting their application and usefulness.

Of all the sclerometers described, only the Bierbaum instrument has retained industrial recognition in America. For the testing of plastic materials, however, its results are not always reliable, and do not necessarily correspond to actual experience (2).

Further studies on scratch resistance using a new type sclerometer developed by the author have been published in *Modern Plastics*.[1] In that study the interrelationships of the four variables involved in making a scratch—namely, load on the scratching tool, velocity of the scratch, tangential force needed to propagate the scratch, and dimension of the scratch—were investigated by means of a specially constructed instrument. On the basis of that work the conclusions were reached that:

1. Scratch resistance should be expressed as the tangential force necessary to propagate the scratch along the surface of the specimen per unit cross-sectional area of the scratch.

2. Scratch resistance should be independent of the load on the scratching tool provided that the material is homogeneous.

3. The resistance to scratching increases as the velocity of scratching increases.

4. The coefficient of sliding friction between the specimen and the scratching tool has an important effect upon scratch resistance.

5. For higher speeds of scratch, the width of scratch is no longer affected appreciably by moderate changes of the scratching speed.

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(3) E. Franke, "Gmelin's Handbuch der anorganischen Chemie," Teil C, Lieferung 1, Härteprüfverfahren, *Verlag Chemie*, G.m.b.H., Berlin, 1937.

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Effect of Temperature on the Rate of Blister Failure of Finishes on Steel in Water Immersion Tests[1]

Prepared by J. A. Boylan[2] and R. I. Wray[3]

Group 2 on Humidity Testing and Group 3 on Immersion Testing of Subcommittee VII of A.S.T.M. Committee D-1 on Paint, Varnish, Lacquer, and Related Products, cooperated in a series of tests to determine the effect of temperature on the rate of blister failure in humidity and water immersion testing. The humidity test results were inconclusive due to variances in the equipment used and in the ability of the equipment to produce condensation on the test specimens. However, the immersion test results brought forth sufficient significant data to present at this time.

Temperatures of 100 F., 110 F., and 120 F. were selected as being the most commonly used in industry for testing finishes for blister failure. As finishes, an automotive finish of medium resistance and a refrigerator finish of high resistance were selected for this study.

The following members of Subcommittee VII cooperated in these tests:

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[1] Report prepared jointly by J. A. Boylan, Chairman, Group 2, and R. I. Wray, Chairman, Group 3, and presented before the meeting of Subcommittee VII (Accelerated Tests), Committee D-1, on Paint, Varnish, Laquer, and Related Products, June 23, 1948.

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[3] Aluminum Research Laboratories, New Kensington, Pa.

TABLE I.—RESULTS OF IMMERSION TEST OF PANELS OF SET A AT VARIOUS TEMPERATURES.

Cooperator	Immersion Test Temp., deg. Fahr.	Average Blister Rating of Three Panels			
		7 Days	14 Days	21 Days	28 Days
I......	100	15% (9)	19% (9)	21% (9)	93% (8-9)
	110	6% (9)	100% (9)	100% (8-9)	100% (8-9)
	120	100% (8-9)	100% (8-9)	100% (8-9)	100% (8-9)
II.....	100	0	(9)[b]	(8)[b]	(8)[b]
	110	0	0	(8)[b]	(8)[b]
	120	0	0	(8)[b]	(8)[b]
III....	100	0	0	0	0
	110	0	0	100% (9)	100% (9)
	120	0	100% (9.5)	100% (7)	100% (6)
IV.....	100	2% (9.5)	2% (9.5)	2% (9.5)	10% (9.5)
	110	33% (9.5)	100% (9.5)	100% (9)	100% (7)
	120	100% (8-9)	100% (6-8)	100% (2-6)	100% (2-4)
V......	100	0.5% (9)	1.6% (7-9)	100% (8-9)	100% (4-9)
	110	0	100% (8-9)	[a]	[a]
	120	100% (8-9)	[a]	[a]	[a]
VI.....	100	0	0	0	73% (6-8)
	110	100% (9)	100% (8)	100% (7)	100% (7)
	120	100% (9)	100% (7)	100% (6)	100% (5)
VII....	100	1% (9.5)	1% (9.5)	1% (9.5)	97% (8)
	110	47% (9.5)	75% (9.5)	100% (8-9.5)	100% (8-9)
	120	100% (9.5)	100% (8)	100% (7)	100% (6)

[a] Removed from test when 100 per cent blistered.
[b] Blister size only reported, not the per cent of area covered with blisters.

TABLE II.—RESULTS OF IMMERSION TESTS OF PANELS OF SET B AT VARIOUS TEMPERATURES.

Cooperator	Immersion Test Temp., deg. Fahr.	Average Blister Rating of Three Panels			
		7 Days	14 Days	21 Days	28 Days
I........	100	1% (9)	2% (8-9)	2% (8-9)	2% (8-9)
	110	0	0	0	0
	120	3% (8)	3% (8)	3% (8)	3% (8)
II.......	100	0	0	0	(9)(a)
	110	0	0	0	0
	120	0	0	0	0
III......	100	0	0	0	0
	110	0	0	0	0
	120	0	0	1% (9.5)	1% (9.5)
IV.......	100	1% (9)	1% (9)	1% (9)	1% (9)
	110	1% (9.5)	1% (9.5)	1% (9.5)	1% (9.5)
	120	0	0	1% (9)	1% (9)
V........	100	0	1% (8-9)	1% (8-9)	1% (8-9)
	110	0	0	0	0
	120	0	0	0	0
VI.......	100	0	0	0	0
	110	0	0	0	0
	120	0	0	0	0
VII......	100	0	0	0	3% (7)
	110	0	0	0	0
	120	0	0	1% (9.5)	1% (9.5)

[a] Blister size only reported, not the per cent of area covered with blisters.

J. A. Boylan, Parker Rust Proof Co.
Wayne Fuller, Grand Rapids Varnish Co.
H. A. Nelson, New Jersey Zinc (of Pa.) Co.
W. F. Singleton, E. I. du Pont de Nemours & Co., Inc.
M. Van Loo, The Sherwin-Williams Co.
R. J. Wirshing, General Motors Corp.
R. I. Wray, Aluminum Company of America

Preparation of Specimens:

Steel panels 4 by 6 in. size conforming to A.S.T.M. Method D 609–46 T[4] were used in the tests. All were cut from sheet steel of the same lot and selected so as to be free of rust and surface blemishes; the panels were all prepared by one cooperator under closely controlled conditions. Each set was treated on a specified date, finished and shipped to the cooperators to be started in the test after identical aging periods.

The surface preparation was as follows:

Set A.—Cleaned according to procedure A of D 609–46 T and finished with an automotive system: 1 Dip Coat Primer and baked 25 min. at 370 F. 1 Dip Coat Enamel and baked 45 min. at 250 F.

Set B.—Cleaned and Phosphate coated according to Procedure B of Method D 609–46 T and finished with a refrigerator system: 1 Dip Coat Primer and baked 20 min. at 350 F. 1 Dip Coat Enamel and baked 30 min. at 280 F.

All finishes were applied using the Fisher-Payne Dip Coater to insure uniform films. The film thickness on the automotive system checked 0.9 to 1.0 mil throughout. On those finished with the refrigerator system, the film thickness measurements were 1.7 to 2.0 mils on the sets tested at 100 F. and 120 F., while those prepared for test at 110 F. were 2.2 to 2.6 mils.

Procedure for Testing:

Each cooperator was sent three groups of triplicate panels prepared by each of the above outlined procedures. His tests were run by immersion in distilled water maintained at the three selected temperatures, 100 F., 110 F., and 120 F., according to the procedure outlined in A.S.T.M. Tentative Method D 870–46 T.[5] Inspections were made at 24, 48, 72, and 96 hr. of the first week and each Monday, Wednesday, and Friday of the following weeks. The final inspection was made after four weeks of test. All ratings were made according to A.S.T.M. Standard Method D 714–45.[6]

Discussion of Results:

The results are summarized in Tables I and II. For simplification only the average rating of the three panels tested is shown. Also, ratings at 7, 14, 21, and 28 days were selected as typical of the blister development trend. The automotive finish used on the panels of Set A (shown in Table I) developed a greater extent of blistering than was observed in the case of the refrigerator finish used on the panels of Set B (see Table II). This difference of behavior of the two finishes may be partially explained by the fact that the panels of Set B were prepared by means of the phosphate coating of procedure B whereas the panels of Set A were solvent cleaned according to procedure A. It is well known that this type of surface treatment has a marked effect on coating adhesion and hence the extent of blister development.

While both sets of panels exhibit a definite relationship between extent of blistering and temperature of the water immersion, the panels of Set A show this relationship to a far greater extent. Neither set showed any great tendency toward rusting. Considering the panels of Set A it will be noted that there is remarkably good agreement among the various cooperators.

[4] Tentative Method of Preparation of Steel Panels for Testing Paint, Varnish, Lacquer, and Related Products (D 609–46 T), 1946 Book of A.S.T.M. Standards, Part II, p. 1601.

[5] Tentative Method of Test for Changes in Protective Properties of Coatings of Paint, Varnish, Lacquer, and Related Products on Steel Surfaces When Subjected to Immersion (D 870–46 T), 1946 Book of A.S.T.M. Standards, Part II, p. 1611.

[6] Standard Method for Evaluating the Degree of Resistance to Blistering of Coatings of Paint, Varnish, Lacquer, and Related Products on Metal When Subjected to Immersion or Other Tests Involving Exposure to Moisture or Liquids (D 714–45), 1946 Book of A.S.T.M. Standards, Part II, p. 1171.

Only one of the cooperators (No. V) reported complete blistering with the automotive system at 100 F. after four weeks of immersion; all reported little or no blistering at this temperature after two weeks of exposure. On the other hand, most cooperators reported 100 per cent blistering after two weeks of exposure of this finish at 110 F. and all but one so reported after three weeks. At 120 F. complete blistering of the panels of Set A was reported by all but two cooperators after seven days of exposure. Also, in most cases the size of blisters increased with increasing temperature after any given length of exposure.

It was also noted that there was very good agreement between the triplicate panels of any cooperator in a given test. Table III includes the ratings of the individual panels of one cooperator and shows the uniformity of failure. This indicates that the coatings were applied at a very uniform film thickness and that the surface treatment of the panels was uniform. While it is true that only two finishing systems were involved in this cooperative investigation, the results obtained appear very encouraging.

TABLE III.—RATINGS OF INDIVIDUAL PANELS OF COOPERATOR I. IN WATER IMMERSION TEST.

	7 Days	14 Days	21 Days	28 Days
		At 100 F.		
1A	2% (9)	3% (9)	8% (9)	100% (9)
2A	3% (9)	4% (9)	5% (9)	100% (9)
3A	40% (9)	50% (9)	50% (9)	80% (8-9)
1B	2% (9)	3% (8)	3% (8)	3% (8)
2B	1% (9)	1% (9)	1% (9)	1% (9)
3B	1% (9)	1% (9)	1% (9)	1% (9)
		At 110 F.		
1A	5% (9)	100% (9)	100% (8-9)	100% (8-9)
2A	5% (9)	100% (9)	100% (8-9)	100% (8-9)
3A	8% (9)	100% (9)	100% (8-9)	100% (8-9)
1B	0	0	0	0
2B	0	0	0	0
3B	0	0	0	0
		At 120 F.		
1A	100% (8-9)	100% (8-9)	100% (8-9)	100% (8-9)
2A	100% (8-9)	100% (8-9)	100% (8-9)	100% (8-9)
3A	100% (8-9)	100% (8-9)	100% (8-9)	100% (8-9)
1B	7% (8)	7% (8)	7% (8)	7% (8)
2B	2% (8)	2% (8)	2% (8)	2% (8)
3B	1% (8)	1% (8)	1% (8)	1% (8)

NOTE.—Rusting and blistering at the edges not included in the above ratings.

Conclusions

The most interesting observation obtained from this investigation was the fact that there appears to be a definite relationship between time and degree of blistering of the paint coating and the temperature at which the immersion test is conducted. The rate of blistering is about doubled with each 10 deg. rise in temperature. This is a very important observation since it would enable the operator to secure results in a far shorter time by increasing the temperature of his immersion bath. Further work is indicated along this line to establish the reproducibility of these results and the application of the test to various types of finishes.

This investigation has also partially proved the validity of the method of test outlined in A.S.T.M. Method D 870–46 T for immersion testing of paint finishes. This test method appears to evaluate better the tendency of paint finishes to blister than their ability to protect the metal against rusting, based on the results of this investigation. Further verification of this point with a variety of paint finishes will be necessary, before it can definitely be established.

A Geiger-Müller Counter Method of Determining Phosphorus in Steels

By Ford R. Bryan[1] and George A. Nahstoll[1]

ANALYTICAL laboratories confronted with the problem of controlling the composition of large volumes of steel are becoming increasingly dependent on the spectrographic method of analysis. Spectroscopy, however, has been greatly handicapped by the extreme difficulty and often impossibility of making determinations of certain critical elements, namely, carbon, sulfur, and phosphorus. In brief, the lack of suitable emission lines within the range of rapid photographic processing methods has deterred the successful analysis for these three elements in steel.

However, a review of the literature indicates that some success has been achieved in analyzing for phosphorus spectrographically. In several instances phosphorus has been determined in materials such as non-ferrous alloys (**9, 10, 14, 15**)[2] and minerals (**13**) by means of customary photographic methods. In these cases relatively high percentages of phosphorus were involved and the number of interfering lines was few. In the case of steel, however, it is often necessary to detect as little as 0.005 per cent phosphorus using a spectrum subject to interference from a multitude of iron lines. The few phosphorus lines sufficiently sensitive and free from interference are found to be in a region of the spectrum requiring ultraviolet sensitized photographic plates and time-consuming processing procedures. Thus, photography of the spectrum is not entirely satisfactory for the analysis of phosphorus in steels.

In 1942 Duffendack and Morris (**3**) of the University of Michigan reported using Geiger-Müller photoelectron counter tubes for the quantitative measurement of spectral lines of wave lengths less than 2600 Å. Since this type of Geiger-Müller tube is sensitive to the wave-length region containing some of the most usable phosphorus lines, a

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[1] Chemical and Metallurgical Research Dept., and Chemical Engineering Dept., respectively, Ford Motor Co., Dearborn, Mich.

[2] The boldface numbers in parentheses refer to the list of papers appended to this paper.

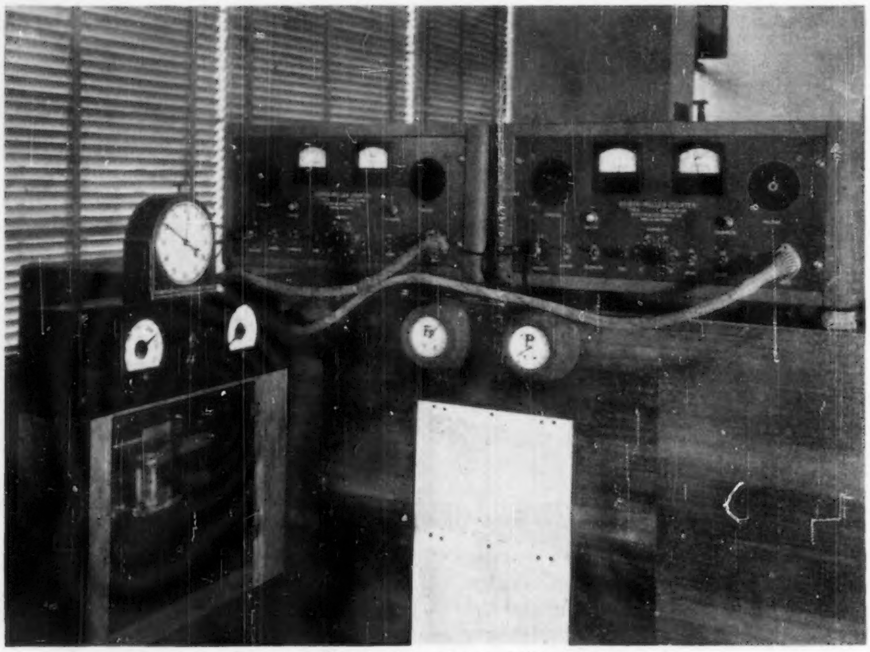

Fig. 1.—Production Control Installation.

project was initiated with the Department of Engineering Research of the University of Michigan to provide Geiger-Müller photoelectron counters and suitable measuring apparatus for analyzing phosphorus in ferrous alloys. This initial investigation has been described by Hanau and Wolfe (**6**). Additional development and application to production control was carried out in the laboratories of the Ford Motor Co. (**1**).

Equipment

The essential equipment consists of: (1) an electrical arc source, (2) a large Littrow quartz spectrograph, and (3) the Geiger-Müller counter attachment with its associated electrical circuits. In contrast to the typical spectrographic installation, this unit does not require a darkroom with photographic processing equipment nor microphotometering facilities. The compactness of this apparatus permits a flexibility of location, as illustrated by Fig. 1 which shows an installation mounted on a chemical laboratory bench.

The excitation source is preferably an arc, since the phosphorus line used (2136.19 Å) is of high arc intensity and is situated very close to a copper line (2135.97 Å) of high spark intensity. Arc excitation has the further advantage of not interfering electrically with the electronic measuring circuits. Both the d-c. arc and a-c. arc (**4**) have been used, although the d-c. arc requires more elaborate operating precautions in order to obtain satisfactory accuracy. In either case a separate motor generator should supply the power, and ballast should be of a constant resistance type.

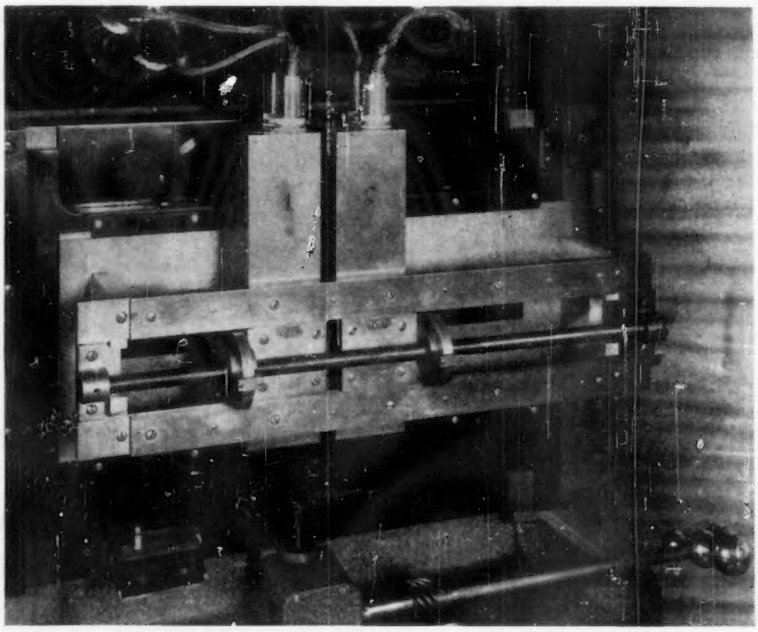

Fig. 2.—Geiger Counter Attachment Mounted to Littrow Spectrograph.

The spectrograph is a Bausch & Lomb Littrow instrument with quartz optics adjusted to bring the "tenth region" into focus, thus providing a reciprocal dispersion of about 1.4 Å per mm. for lines of 2100 to 2200 Å wave length. In order to control the temperature of the instrument and thus prevent shifting of the spectral line positions at the focal plane, the complete spectrograph is enclosed in a thermostat consisting of a wooden cabinet insulated with a lining of ½-in. felt, fitted with a small fan for circulating air, and equipped with a Taylor mercurial thermoregulator and electrical heating element of about 400 watts

Two Geiger counters are attached to the spectrograph at the plateholder position, replacing the photographic plates usually employed. Interchange of tubes and photographic plate can be readily accomplished if desired. Figure 2 depicts the attachment which carries the Geiger-Müller tube containers and which fits into the position usually occupied by the plateholder. The box-like containers are equipped with receiving slits and counter tubes aligned to accommodate incident light beams striking the focal plane at an angle of about 65 deg. from the normal. These tube containers are movable along a screw having 24 threads to the inch, allowing reproducible location of the slit and tube positions to within 10 μ.

The Geiger tube, shown in Fig. 3, is of unique construction and exceptionally small size, being about 12 cm. in length and 13 mm. in diameter. These tubes are a non-selfquenching, photoelectron counting type based on the experimental work of Duffendack and others (**2, 3**), who applied such tubes to the measurement of spectral lines. The electrical elements of the tube consist of a cylindrical nickel alloy cathode and a fine tungsten wire anode supported within a tubular quartz envelope filled with pure hydrogen gas at 10 cm. pressure.

The spectral sensitivity of the tube is dependent primarily on the properties of the elements nickel and hydrogen. Nickel will release photoelectrons to produce counts only if radiant energies of 5.01 electron volts (e.v.) or greater are received. This photoelectric threshold

Fig. 3.—Quartz Geiger Counter Tube.

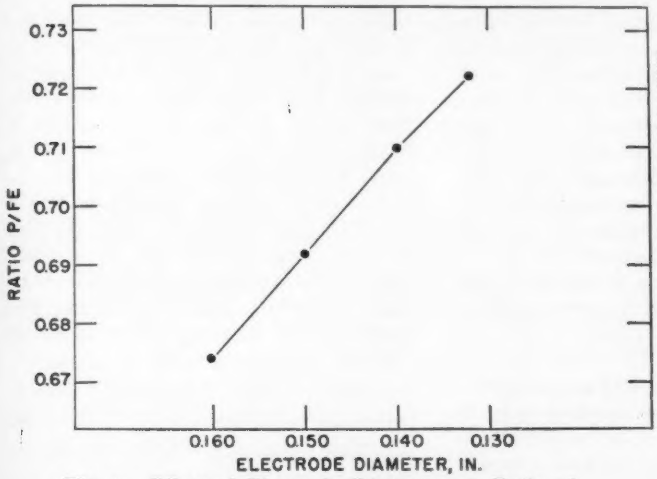

Fig. 4.—Effect of Electrode Diameter on Ratio of Phosphorus Counts to Iron Counts.

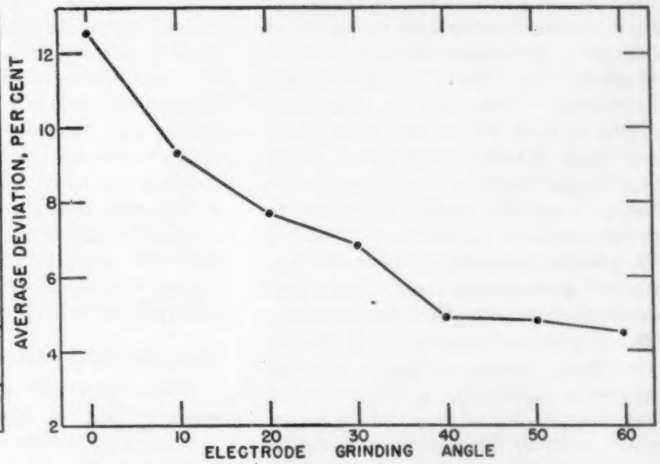

Fig. 5.—Influence of Grinding Angle on Precision of Ratio Readings.

Average deviations are computed on the basis of ten exposures run at each of the seven angles chosen.

of nickel thus limits the tube's longer wave-length sensitivity to about 2600 Å. If radiant energies of 13.5 e.v. or more are received into the tube, the hydrogen gas will ionize and impair counting, thus limiting the shorter wave lengths measurable to 910 Å. The quartz envelope, of course, further limits the sensitivity to a range of 2600 Å to 1800 Å. A potential difference of about 800 volts d.-c. is required between anode and cathode. Operating plateaus of about 150 v. are characteristic, and the nonselfquenching hydrogen gas, providing no metastable states, contributes to the stability and long life of the tube. Tubes of this construction have been in use for more than two years without noticeable change in sensitivity or operating characteristics.

Each tube requires a group of associated electronic circuits for counting. Pulses from the tubes are quenched externally by means of a Neher-Harper (12) circuit. These isolated pulses, which are very feeble and may occur at a rate too rapid for mechanical registering, are next fed into a scaling circuit of Lifschutz (7) design, which produces one relatively powerful pulse for each eight original weak pulses. The high-voltage regulated power supply for the Geiger tube is also incorporated with the scaling circuit. The pulse delivered from the scaling circuit then drives a solenoid-operated impulse register to totalize the number of counts per unit time. Although the counting rates involved in measuring spectral lines are not high, the random occurrence of the pulses necessitates consideration of the electrical resolution (8) of counts occurring at nearly the same time. The combined electrical circuits will count accurately as many as 3600 equally spaced, scaled counts per minute; but the probability of coincidence in counting random pulses contributes an error which is quite significant at rates above 500 scaled random counts per minute. Likewise, in measuring random counts, accuracy of measurement is dependent on the total number of pulses counted; and errors tend to increase with a decrease in total counts registered. A provision for the interpolation of registered counts is incorporated in the counting circuit used.

Procedure for Analysis

In an attempt to restrict errors to within 5 per cent of the amount of phosphorus present, the operation of the equipment has required meticulous adjustment, especially in regard to factors influencing the stability of the arc source. The following procedure for analysis includes specific conditions which must be maintained and also the effects produced by excessive variation of some of these conditions.

Sample Preparation and Loading:

Molten metal to be analyzed is poured into molds to provide rod-shaped self electrodes characterized by (1) diameters uniform to within 0.005 in., (2) lengths of at least 0.625 in., and (3) burning tips consisting of 90 deg. cones.

Sample electrodes of 0.145 in. diameter are found to be satisfactory with arc currents under 2 amp.; however, larger electrodes are preferable when higher current values are required for greater element sensitivity. After the adoption of a usable diameter, it is most important to maintain the uniformity of the samples in respect to each other and to standards employed. The ratio of phosphorus counts to iron counts varies inversely as the electrode diameter, and even very small changes in diameter affect counting results, as is shown in Fig. 4. A total diameter range of from 0.133 in. to 0.160 in. was found among samples obtained from glass tubing within a single bore specification. Unless commercial hard glass tubing is graded for diameter uniformity it is considered unsatisfactory for accurate arc analysis.

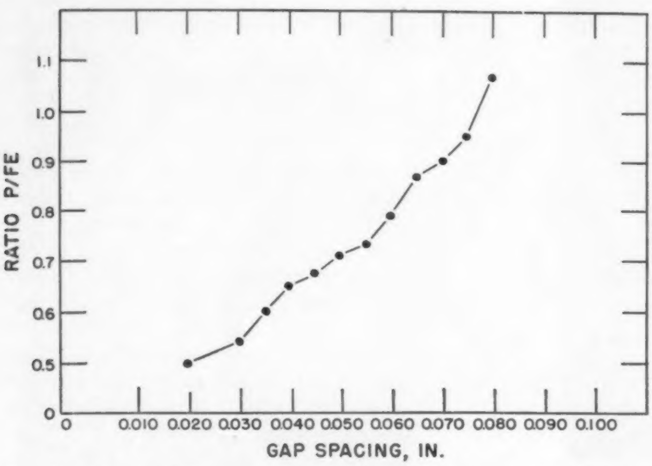

Fig. 6.—Effect of Gap Spacing on Ratio of Phosphorus Counts to Iron Counts

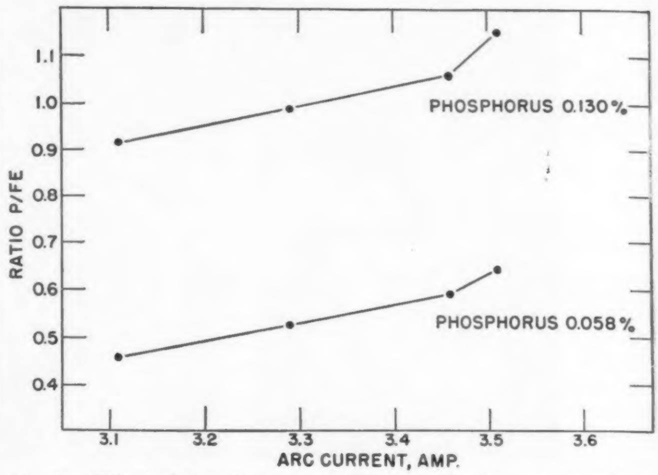

Fig. 7.—Effect of Arc Current on Ratio of Phosphorus Counts to Iron Counts.

Sample rods of less than 0.625 in. in length in combination with diameters of of 0.130 in. to 0.250 in. are found to give definitely high and nonreproducible phosphorus readings. Electrode lengths of from 0.75 in. to 2.0 in. have been used satisfactorily, although at these longer lengths it appears preferable to keep the length dimension to within a range of ± 0.25 in.

A grinding operation removes 45 deg. of metal as measured from a plane perpendicular to the length of the electrode, forming a conical burning tip of 90 deg. Trials with various amounts of metal removed indicated that grinds removing more than 40 deg. of material are necessary in order to minimize average deviations in results (Fig. 5). Without a sharp conical point, there is a definite tendency toward arc wandering, which in prism instruments results in considerable variation of quartz absorption (8) and in poor reproducibility of readings.

Spacing the sample electrodes to form the arc gap requires extreme attention since reproducibility of readings can be maintained only with uniform gap distance. The relationship between gap spacing and the ratio of phosphorus counts to iron counts is shown in Fig. 6. To provide reproducibility within 5 per cent of the amount of phosphorus present, it is necessary to maintain gap spacing within ±0.005 in. from sample to sample.

Source Conditions:

Both a-c. and d-c. arcs have been used with currents from 1.5 to 3.5 amp., depending on the power available and on the diameter of the electrodes to be analyzed. The 2200-v. a-c. arc of 2 amp. is satisfactory for most samples. Excessive currents through small electrodes produce burning irregularities leading to errors in analysis, whereas low currents, on the other hand, may reduce sensitivity to a point where small amounts of phosphorus will not produce sufficient counts for accurate measurement. After the optimum current value is chosen, it is imperative that suitable regulation be available to maintain constancy within about 0.05 amp. Figure 7 indicates that electrodes of various compositions are affected similarly by arc current variation. The same tendency is apparent through the entire range of electrode diameters used. If current stability is maintained by means of voltage regulation, it is necessary to control a 220-v. supply to within ±3.0-v.

Spectrograph Adjustment:

The arc is positioned 35 cm. from the entrance slit of the spectrograph, a proximity requiring close optical alignment but an aid in producing sensitivity required for the detection of small percentages of phosphorus. An auxiliary lens was found to detract from the evenness of slit illumination with slight shifts in arc position during exposures. The spectrograph entrance slit is adjusted to 30 μ in width and 7 mm. in height, while exit slits attached at the spectrograph focal plane are 200 μ in width and 6.3 mm. in height. Entrance slit widths of more than 30 μ prevent sufficient resolution for the steel spectrum, and narrower widths reduce sensitivity. The line produced at the focal plane is effectively 70 μ in width, and, if isolated from other lines and well centered within the exit slit, allows a shift in either direction of approximately its own width without affecting results appreciably. It is imperative that entrance and exit slits be made parallel to each other. This can be accomplished by narrowing the exit slits to the width of a line and by rotating the entrance slit housing to a position where a maximum count is obtained. The spectrograph focus and tilt adjustments are set to accommodate the 2100 A to 2500 Å region, which offers a reciprocal dispersion of 1.4 Å per mm. at the position of the 2136.19 Å phosphorus lines.

Choice of Lines:

Several fairly sensitive phosphorus lines and many satisfactory iron reference lines are available in the wavelength region from 2100 Å to 2500 Å Of the phosphorus lines in steel, the one at 2136.19 Å is the most usable because

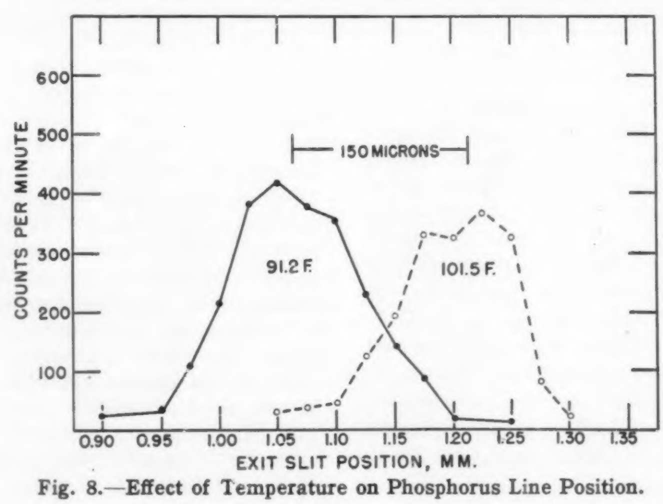

Fig. 8.—Effect of Temperature on Phosphorus Line Position.

of its high arc intensity and relative freedom from interference. The nearest interfering line is the copper line at 2135.97 Å, whose interference can be minimized by the use of the arc. Of the iron reference lines, one at 2219.9 Å was chosen primarily because its intensity is nearly equivalent to that of the 2136.19 Å phosphorus lines, and secondly because its proximity to the phosphorus line results in a minimum quartz absorption error. The ratio of intensities of two prism dispersed lines has been found to vary less as the difference in wave length between the lines decreases (**6**).

Proper adjustment of the exit slits in relation to the line positions requires considerable care. A line such as the reference which is free of adjacent interfering lines can be located for measurement quite simply by means of a scanning procedure wherein the increase or decrease in counts can be attributed to the line edges and a half-way point adopted as the proper position of the exit slit. Locating an exit slit accurately over the phosphorus line, however, is more difficult because of the copper line 2135.97 Å, the center of which is only 0.23 Å from the midpoint of the phosphorus line. These two lines are resolved with difficulty, and it has been found expedient to locate the exit slit for phosphorus by noting the sharp increase in counts as the edge of the relatively intense copper line enters the slit. Approaching again to within 50 μ of that same edge places the exit slit directly over the phosphorus line. Adoption of a single direction of scanning is necessary because of the backlash of the mechanism.

Temperature Regulation:

Because of the adjacency of the phosphorus and copper lines, it is necessary to minimize the shifting of the line positions in reference to the stationary exit slits. A rise in the temperature of the prism can cause a shift of the lines toward the red end of the spectrum to an extent sufficient to cause the phosphorus line to leave the exit slit at least partially during normal room temperature variations. Experimentation with a temperature-controlled instrument revealed a shift of approximately 15 μ per deg. Fahr. (Fig. 8). It has been found necessary to control the temperature of the spectrograph to within ± 2 F. in order to prevent inaccurate measurements. When such temperature control is not available, exit slits must be manually adjusted to compensate for spectral line shift, a procedure not suitable for routine control analysis.

Electronic Units:

The electronic circuits attached to each Geiger-Müller tube must be adjusted according to the characteristics of the particular tube with which they are associated. A variable d-c. voltage supply is used first to determine the operating plateau of the tube. The voltage is then set for regulation at the midpoint of the plateau and both voltage and stabilizing knobs locked into position to avoid accidental overvoltage, which may injure the tube or contribute error to results. Experience indicates that, once the operating voltage has been established it may be possible to employ a given tube for more than two years without altering this voltage. Whenever voltage is applied to the tubes, occasional counts occur because of cosmic radiation; however, the number is small and does not contribute an error of great consequence. A small independent pulsing circuit is used to reset the register to zero after each exposure.

Exposures:

The choice of exposure time may be based on several factors but invariably results in a period which is a compromise between speed and accuracy of analysis. Presupposing that arc current has been matched to electrode size so as to produce fairly uniform "time of wait" characteristics, there remain essentially two limitations in the counting procedure which must be considered. The first of these is the necessity of keeping the exposure time to a minimum in order to make the procedure practical as a high-speed, routine control method. The second limitation is the fact that the measurement of random counting rates becomes more accurate as the totalized number of counts is allowed to increase. Therefore, with a given light intensity an increased exposure time becomes an advantage to accuracy. The mathematical calculation of probable error in counting random counts reveals that a minimum of 31 scaled and registered counts must be totalized to provide an error of less than 5 per cent. At a nominal phosphorus content of 0.03 per cent, a time of one minute may be required to accumulate 30 scaled phosphorus counts. Larger percentages of phosphorus may be analyzed with 5 per cent error in less than one minute of exposure time while phosphorus contents under 0.03 per cent may warrant exposure times longer than one minute for equivalent accuracy. During a one minute arcing of most steels, sufficient phosphorus counts are produced to provide acceptable accuracy, and about 100 counts are accumulated from the iron reference line. Terminating the exposure at the time 100 reference counts are registered has proved to be a satisfactory compromise between speed and accuracy of analysis as well as being an expeditious means of calculating ratios and drawing up working curves.

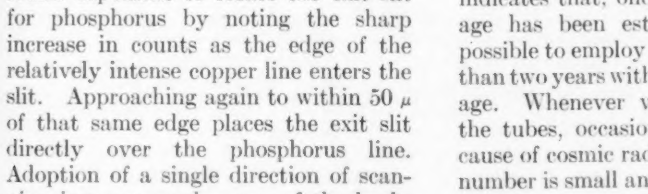

Fig. 9.—Working Curve for Analysis of Low Phosphorus Steels.

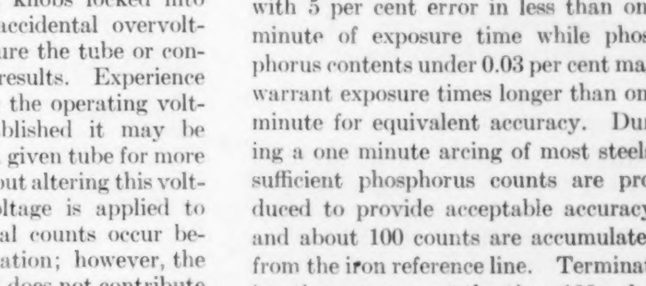

Fig. 10.—Working Curves for Alloys Differing Primarily in Carbon Content.

Analytical Curves:

By using electrodes of known analysis, readings obtained from the registers provide phosphorus to iron count ratios which may be plotted against the known percentages of phosphorus to produce a working curve. By terminating the exposure at the time that exactly 100 reference counts occur, phosphorus counts may be plotted directly against the percentage of phosphorus and the necessity for calculating the ratio of phosphorus to iron avoided. Curves covering the range of from 0.006 per cent to above 0.20 per cent phosphorus have been prepared to accommodate various types of steels. Figure 9 shows a working curve for a low phosphorus range. As with photographic procedures, separate working curves may be necessary for steels differing appreciably in alloy content. Carbon variation, especially, is apt to require independent curves for a given percentage range of phosphorus (Fig. 10). Standard electrodes are not readily available for the preparation of analytical curves for phosphorus. Therefore, preparation of the working curve for each type of metal has required the accurate chemical analysis of specially cast electrodes for use as standards.

Results

Included in these results are data derived from two separate installation locations; the first, in an experimental laboratory, employed the 2200-v. a-c. arc, and the second, in a production laboratory, employed a 220-v. d-c. arc source.

Types of alloys tested and typical results obtained with the experimental installation are shown in Table I. A range of from 0.007 to 0.21 per cent phosphorus and three sizes of electrode diameters were present among these samples obtained from production departments. The chemical determinations were single determinations made by control analysts using the colorimetric method of Hague and Bright (**5**). Data collected from a larger number of determinations are compiled in Table II, where it can be seen that the results are of sufficient accuracy to be usable in furnace control of commercial irons and steels. From 346 determinations on typical production alloys, average deviations from the mean were found to range from 0.001 to 0.004 per cent phosphorus. Average deviations from routine chemical analyses extend from 0.002 to 0.008 per cent phosphorus, with the greater deviations occurring, as might be expected, among samples containing the higher phosphorus concentrations.

TABLE I.—A COMPARISON OF GEIGER COUNTER AND ROUTINE CHEMICAL ANALYSES ON SOME TYPICAL IRONS AND STEELS USING THE 2200-VOLT ALTERNATING-CURRENT ARC.

Type of Sample	Rod Diameter, in.	Chemical Analysis, per cent phosphorus	Geiger Counter Analysis, per cent phosphorus
Low carbon No. 1	1/4	0.007	0.008/0.009/0.008/0.008
Low carbon No. 1	1/4	0.011	0.015/0.014/0.012/0.014
Low carbon No. 2	1/4	0.010	0.009/0.010/0.008/0.009
Low carbon No. 2	1/4	0.009	0.008/0.012/0.011/0.012
Low carbon No. 3	1/4	0.013	0.012/0.012/0.009/0.011
Ford EEEE	1/4	0.019	0.020/0.019/0.018/0.020
Crankshaft metal	1/8	0.046	0.053/0.047/0.054/0.053
Crankshaft metal	1/8	0.055	0.059/0.062/0.055/0.051
Crankshaft metal	1/8	0.040	0.046/0.053/0.037/0.036
Crankshaft metal	1/8	0.055	0.055/0.055/0.056/0.049
Crankshaft metal	1/8	0.028	0.027/0.025/0.023/0.023
Crankshaft metal	1/8	0.038	0.036/0.044/0.041/0.034
SAE 1111	1/8	0.092	0.103/0.099/0.085/0.083
SAE 1111	1/8	0.145	0.133/0.137/0.139/0.134
SAE 1111	1/8	0.108	0.101/0.104/0.114/0.109
SAE 1111	1/8	0.088	0.105/0.108/0.106/0.107
Rimmed steel	1/8	0.005	0.007/0.006/0.005/0.009
Rimmed steel	1/8	0.006	0.013/0.011/0.014/0.010
Cupola AA iron	3/16	0.17	0.169/0.162/0.175/0.163
Cupola AA iron	3/16	0.17	0.168/0.165/0.176/0.168
Cupola AA iron	3/16	0.165	0.164/0.161/0.157/0.167
Cupola B iron	3/16	0.20	0.185/0.183/0.180/0.190
Cupola B iron	3/16	0.19	0.195/0.187/0.204/0.190
Cupola B iron	3/16	0.19	0.197/0.205/0.203/0.195

TABLE II.—GEIGER COUNTER RESULTS ON TYPICAL IRONS AND STEELS USING THE ALTERNATING-CURRENT ARC.

NOTE.—Columns headed, "...Deviation from Mean" were derived by averaging deviations rom the mean of each of four separate determinations made on each sample.

Type of Sample	Determinations	Concentration Range, per cent phosphorus	Maximum Deviation from Mean, per cent phosphorus	Average Deviation from Mean, per cent phosphorus	Maximum Deviation from Chemical Analysis, per cent phosphorus	Average Deviation from Chemical Analysis, per cent phosphorus
Open hearth, low carbon	98	0.005 to 0.021	0.004	0.001	0.006	0.002
Electric furnace crankshaft	92	0.028 to 0.066	0.007	0.002	0.015	0.004
Electric furnace piston	28	0.045 to 0.067	0.003	0.001	0.008	0.003
Electric furnace miscellaneous	36	0.080 to 0.145	0.015	0.004	0.020	0.008
Cupola furnace cylinder blocks	92	0.100 to 0.200	0.013	0.004	0.020	0.008

TABLE III.—GEIGER COUNTER RESULTS ON FOUNDRY SAMPLES USING THE DIRECT-CURRENT ARC.

Type of Sample	Determinations	Concentration Range, per cent phosphorus	Maximum Deviation from Chemical Analysis, per cent phosphorus	Average Deviation from Chemical Analysis, per cent phosphorus
Cupola iron	109	0.10 to 0.25	0.035	0.013
Electric furnace preliminaries cast in iron	96	0.02 to 0.07	0.018	0.006
Electric furnace preliminaries cast in molybdenum	15	0.02 to 0.07	0.005	0.002

The second installation location is in a production laboratory and was chosen on the basis of need for rapid determinations of phosphorus in preliminary samples taken from electric furnace crankshaft metal heats. The spectrometric equipment was mounted on a chemical work bench where a 220-v. d-c. arc was used because of safety requirements. This installation has now been in use for approximately ten months, serving the foundry in controlling phosphorus content of electric furnace and cupola furnace heats, and to date some 7000 heats have been analyzed effectively. Representative results of the foundry application using the d-c. arc are shown in Table III. It is apparent that the 0.006 per cent and 0.013 per cent deviations from routine chemical results are somewhat greater than corresponding deviations obtained with the a-c. arc. The accuracy of analysis of steel samples poured at relatively high temperatures has been improved by casting the specimens in pure molybdenum rather than cast-iron molds. The improved physical structure of the specimen pins apparently is responsible for the more consistent analytical results. The average deviation of the crankshaft analysis has been reduced to 0.002 per cent in trials with the molybdenum mold. Duplicate determinations are made and average for each sample whenever the first result is near specification limits.

An operator can make a single deter-

mination in 2 min. or 30 in an hour. The speed of the analysis permits effective control, as heats can be held in the furnace for sufficient time to determine if they are high in phosphorus and diluted if necessary with low phosphorus material to bring them within specification before pouring.

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Study of A.S.T.M. Tentative Stiffness Test as Applied to Rubber

By Dietrich G. Stechert[1]

SYNOPSIS

The reduction of experimental cantilever bending test measurements to fundamental elastic properties is complicated especially for rubber because Hooke's law does not apply to this material. The theory of cantilever bending under large deflections, based on a parabolic stress-strain function, is developed in some detail. The theory, together with a large number of experimental determinations on four rubber compounds, leads to the conclusion that a fundamental measure of elasticity cannot be obtained in a practical manner by use of the A.S.T.M. Tentative Method of Test for Stiffness in Flexure of Non-Rigid Plastics (D 747 – 43 T).[2]

The use of a cantilever bending test for the determination of elastic and plastic properties of materials has at least two very definite advantages over other tests designed to measure these properties: the relative simplicity of the test and the compactness of the test apparatus. Test samples of simple and constant cross-section—rectangular, square, or circular—can be used. No special dies or molds are needed for sample preparation. Test samples may be cut from molded sheets. The test device need not be complicated. Its essential elements are a holding vise of simple design, a method for applying a known load at the free end of the cantilever specimen, and means of measuring the deflection of the specimen.

A bending test, however, also has some serious shortcomings. The conversion of experimental measurements into fundamental elastic properties is complicated by the fact that, in bending, specimens are not uniformly strained, but are subjected, under any given set of conditions, to different degrees of both tensile and compressive strain. Further complications arise for rubber because, in general, stress does not vary linearly with strain for this material.

The A.S.T.M. Tentative Test for Stiffness in Flexure of Non-Rigid Plastics (D 747 – 43 T)[2] is designed to meet the demand for a simple cantilever bending test. The use of a test device based on a design credited to Tour, Marshall, and Olsen is recommended. A formula is given[3] for converting experimental measurements into a relative index of flexibility referred to as "stiffness in flexure."

The testing of various rubber compounds under different conditions of test on an Olsen Stiffness Tester of 6 in.-lb. capacity following A.S.T.M. Method D 747 – 43 T, revealed that "stiffness in flexure" is indeed not a fundamental property, but a measure of flexibility relative to any given set of test conditions, such as pendulum weight, deflection, span length, and test specimen dimensions.

An explanation was sought. It was found that "stiffness in flexure" is the modulus of elasticity of a cantilever beam subjected to a concentrated load at the free end, as derived in the study of the strength of rigid materials suffering small deflections only. The validity of one of the assumptions of the derivation, in particular, was questioned—that the slope of the elastic curve at any point is always so small that it can be considered negligible—especially since the test is designed so that specimens can be subjected to angular deflections ranging from 0 to 90 deg.

Consequently the theory of cantilever

NOTE.—DISCUSSION OF THIS PAPER IS INVITED, either for publication or for the attention of the author. Address all communications to A.S.T.M. Headquarters, 1916 Race St., Philadelphia 3, Pa.

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[2] 1946 Book of A.S.T.M. Standards, Part III-B, p. 895.

[3] The boldface numbers in parenthesis refer to the references appended to this paper.

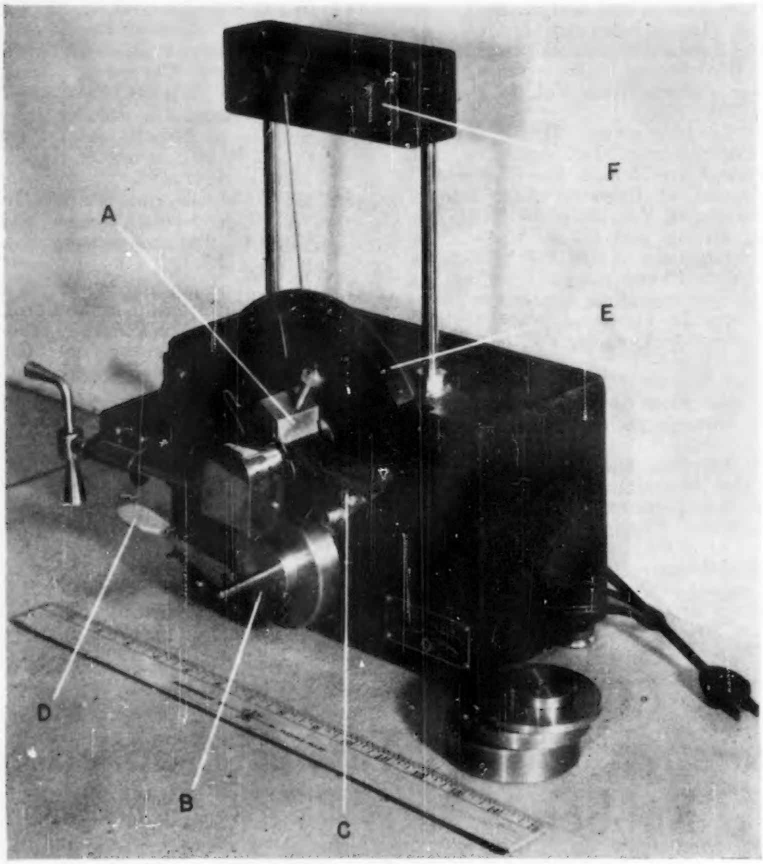

Fig. 1.—Olsen Stiffness Tester 6–in. lb. Capacity.

A-Vise
B-Detachable pendulum weights
C-Bending pin
D-Motor engaging lever
E-Angular deflection scale
F-Load scale

bending under large deflections was developed in some detail. A formula for the modulus of elasticity, that is not based on the foregoing assumption, was derived. The formula was tested using measurements made on four rubber stocks under several different conditions of load, deflection, and span, and for different specimen widths and thicknesses. Modulus values thus computed were observed also to depend on test conditions and specimen dimensions.

Attempts to refine the derivation for modulus, by eliminating certain other simplifying assumptions, proved impractical.

It is therefore proposed that A.S.T.M. Method D 747 – 43 T be employed for measurements relative to certain arbitrarily standardized test conditions and specimen dimensions. It is further recommended that a relative modulus of elasticity be computed by the proposed formula.

Details of Stiffness Test

Certain details of the stiffness test are presented here for a ready understanding of the test. For a complete description see the Tentative Method of Test for Stiffness in Flexure of Non-Rigid Plastics (D 747 – 43 T),[2] from which the following information was taken.

The test is well suited for determining relative flexibility over a wide range. The test method does not distinguish between or separate the elastic and plastic components of the deformation in bending, and a true elastic modulus is therefore not calculable. Instead, an apparent value is obtained and is defined for purposes of the test as the "stiffness in flexure."

The Olsen Stiffness Tester, of Tour, Marshall, and Olsen design, is recommended for the performance of the test A 6 in.-lb. capacity tester is shown in Fig. 1. The apparatus consists essentially of: (*A*) a vise to which an angular deflection scale pointer is attached and which is capable of being uniformly rotated in a clockwise direction by depressing the motor engaging lever; (*B*) a pendulum weighing system, including an angular deflection scale, load scale pointer, a bending plate or pin, and a series of detachable weights, this system being pivoted to turn about the same axis of rotation as the vise; (*E*) an angular deflection scale which indicates the angle through which the vise has been rotated relative to the pendulum system; (*F*) a load scale calibrated so that the load scale reading times the total of the applied calibrated weights and divided by 100 gives the bending moment directly.

Test specimens shall be strips cut from molded sheets, and they shall have a rectangular cross-section.

The test procedure consists essentially of clamping a test specimen in the vise, applying force moments in increments by depressing the motor engaging lever accordingly, and taking corresponding readings of the load and deflection scales.

The A.S.T.M. test method further designates that the "stiffness in flexure," E′, in pounds per square inch, shall be calculated to three significant figures by the formula:

$$E' = \frac{pWb}{3\beta I} \qquad (1)$$

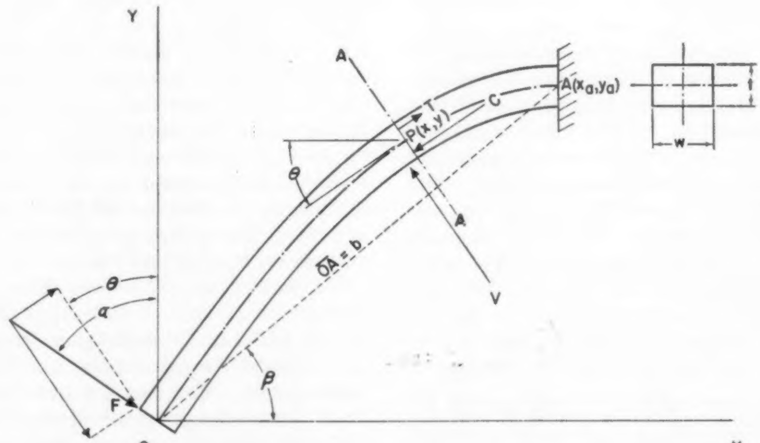

Fig. 2.—Cantilever Beam Subjected to Large Deflection Under Concentrated Normal Load

where:

p = load scale reading divided by 100,
W = total of calibrated weights applied to pendulum system,
b = span length in inches,
β = angular deflection in radians, and
I = second moment of cross-sectional area of specimen about its centroidal axis, in quartic inches. For a rectangular area $I = wt^3/12$, where w and t are specimen width and thickness, respectively, in inches.

The necessary conditions and assumptions for this formula will become clear in the theory discussed below.

It was felt that the observed failure of Eq. 1 to give even reasonably constant values of E' for different test conditions was due to the nature of the conditions and assumptions on which the formula is based. It was therefore deemed advisable to investigate the theory of cantilever bending for large deflections in some detail.

Theoretical Considerations

The theory developed below is based on the following conditions:

1. The test specimen is straight before bending.
2. The specimen is of such dimensions that there is no twisting or lateral collapse of the specimen during the test.
3. The test specimen is of constant rectangular cross-section.
4. The force acting on the free end of the cantilever specimen always acts normal to the surface of the specimen at the point of contact. This can be assured through replacement of the fixed bending plate or pin by a pin of small diameter that is free to rotate on its axis, or possibly through lubrication of the fixed plate or pin.
5. The ratio of specimen thickness to test span is relatively small, and the bending pin is of relatively small diameter.

The assumptions on which the theory is based are:

1. Axial fiber strain varies directly with the distance of the fiber from the neutral axis.
2. The effect of shearing strain on axial strain is negligible.
3. The weight of the specimen is so small, compared to the force needed to bend the cantilever, that it can be considered negligible.
4. Measurements can be made rapidly so that time effects such as creep and stress-relaxation can be held to a minimum.

Because of the fact that, for rubber, stress does not vary linearly with strain, a reasonable stress-strain function must be selected. Various such functions have been reported in the literature. One whose form is generally agreed on (**1, 2, 3, 4, 5, 6, 7**)[3] is:

$$\sigma = P[1 + \epsilon - (1 + \epsilon)^{-2}]$$

$$= 3P(\epsilon - \epsilon^2 + \frac{4}{3}\epsilon^3 - \frac{5}{3}\epsilon^4 + \ldots)$$

where:

σ = stress based on undeformed cross-sectional area,
ϵ = unit strain, and
P = factor dependent on temperature and molecular structure and weight.

Another investigator (**8**) reports:

$$\sigma = \frac{A\epsilon}{\epsilon + B}$$

where A and B are empirical constants for any given rubber stock. The value of B was reported as approximately equal to unity. If $B = 1$:

$$\sigma = \frac{A\epsilon}{\epsilon + 1} = A(\epsilon - \epsilon^2 + \epsilon^3 - \epsilon^4 + \ldots)$$

On the basis of these functions which were reported to be applicable over considerable ranges of strain, and since only a relatively small range of strain (on the order of 25 per cent tensile and compressive strains at most) is covered in a bending test, let us use a function of the form:

$$\sigma = a\epsilon - b\epsilon^2 \ldots\ldots\ldots\ldots(2)$$

where a and b are characteristic, positive constants.

It will be necessary to determine the location of the neutral axis at any section of the cantilever beam. Figure 2 represents a cantilever beam under the action of a force F applied at the free end in such a way that it always acts normal to the elastic curve at the point of application. Let $P(x, y)$ be any point on the elastic curve, and A-A be a section normal to the elastic curve at P. Consider now the free-body of the part of the beam to the left of A-A. If T and C are the sums of the tensional and compressional fiber stresses, respectively, acting on section A-A, and if F is resolved into components acting parallel and perpendicular to the direction of forces T and C, then:

$$F \sin(\alpha - \theta) + T - C = 0 \ldots\ldots(3)$$

But if the beam is of rectangular cross-section:

$$T - C = w \int_{-k_n t}^{(1-k_n)t} \sigma\, dz \ldots.(4)$$

where:

w = beam width,
t = beam thickness,
z = distance of fiber from neutral axis, and
k_n = d/t = neutral axis constant, where d is the distance from the bottom (on the compression side) of the beam to the neutral axis.

Assumption 1 above may be written:

$$\epsilon = z/\rho \ldots\ldots\ldots\ldots(5)$$

where ρ = radius of curvature of elastic curve.

Substituting Eqs. 2 and 5 in Eq. 4, integrating, substituting the resulting value of $T-C$ in Eq. 3, and solving for k_n:

$$k_n = \frac{1}{2}\left[1 - \frac{1}{r} \pm \left(\frac{1}{r^2} - \frac{1}{3} + 4p\right)^{1/2}\right]$$

where:

$$r = \frac{bt}{a\rho} \text{ and}$$

$$p = \frac{F\rho^2}{bwt^3} \sin(\alpha - \theta).$$

But the following condtions prevail: $a > 0$; $b > 0$; $F > 0$; $\rho > 0$; $w > 0$; $t > 0$; $\sin(\alpha - \theta) \geqq 0$ for $0 < \alpha \leqq \pi$; $0 < k_n < 1$. Therefore $r > 0$ and $p \geqq 0$. It is further necessary that $1/r^2 + 4p \geqq \frac{1}{3}$. Therefore:

$$k_n = \frac{1}{2}\left[1 - \frac{1}{r} + \left(\frac{1}{r^2} - \frac{1}{3} + 4p\right)^{1/2}\right] \ldots(6)$$

Now the bending moment M at section A-A can be written:

$$M = w \int_{-k_n t}^{(1-k_n)t} \sigma z\, dz \ldots\ldots(7)$$

Substituting Eqs. 2 and 5 in Eq. 7, integrating and substituting the value of k_n of Eq. 6 in the resulting expression:

$$M = \left[\frac{wt^4}{12\rho^2} + \frac{Ft}{2b}\sin(\alpha - \theta)\right] \left\{\rho^2\left[\frac{a^2}{t^2} + \frac{4b}{wt^3}F\sin(\alpha - \theta)\right] - \frac{b^2}{3}\right\}^{1/2} - \frac{aF}{2b}\sin(\alpha - \theta) \ldots(8)$$

where:

M = $F(x \cos\alpha + y \sin\alpha)$,
ρ = $\left|\frac{ds}{d\theta}\right|$, and
s = length of elastic curve from O to P.

Solution of this differential equation is possible only through graphical or numerical integration, it is believed Since no general analytic solution seems possible, the practical value of Eq. 8 is problematical.

Let us see if, through making further assumptions, it will be possible to obtain a general solution for the elastic curve equation of a cantilever beam. If the stress-strain function of Eq. 2 is sacrificed in favor of Hooke's law, $s = E\epsilon$, where E is the modulus of elasticity in tension and compression, then:

$$k_n = \frac{1}{2} + \frac{F\rho}{Ewt^2}\sin(\alpha - \theta) \ldots.(9)$$

and

$$M = \frac{EI}{\rho} + \frac{F^2\rho}{EA}\sin^2(\alpha - \theta) \ldots (10)$$

where:

$I = wt^3/12$ and

$A = wt.$

No general analytic solution for Eq. 10 has been found. It is of the form:

$$a_1\frac{d^2\theta}{ds^2} + a_2\sin^2(\alpha - \theta)\frac{d^2\theta}{ds^2}\left(\frac{d\theta}{ds}\right)^{-2} + a_3\sin 2(\alpha - \theta) + a_4\cos(\alpha - \theta) = 0$$

where a_1, a_2, a_3, a_4 are constants.

If a still further simplifying assumption is made, that the neutral axis and the centroidal axis at any section of the beam concide, that is, that $k_n = \frac{1}{2}$, then it can be shown from Eq. 7 that:

$$M = \frac{EI}{\rho} \ldots\ldots\ldots\ldots (11)$$

It follows that:

$$EI\frac{d\theta}{ds} = -F(x\cos\alpha + y\sin\alpha) \ldots (12)$$

where $0 < \alpha \leqq \pi$.

The angle α is restricted to the indicated range because it represents the extent of our practical interest. The minus sign is introduced because $F > 0$ and $ds/d\theta < 0$, and further, if $0 < \alpha \leqq \pi/2$, it follows that $x \geqq 0$ and $y \geqq 0$. If, however, $\pi/2 < \alpha < \gamma$, where γ is an angle such that for values of $\gamma < \alpha < \pi$ the beam lies entirely to the left of the y-axis, then it can be shown (see below) that $(x\cos\alpha + y\sin\alpha) > 0$. And if $\gamma \leqq \alpha \leqq \pi$, then $x < 0$, $\cos\alpha < 0$, $y\sin\alpha > 0$, and it follows that $(x\cos\alpha + y\sin\alpha) > 0$.

Differentiating Eq. 12 with respect to s and using $dx = ds\cos\theta$ and $dy = ds\sin\theta$:[4]

$$EI\frac{d^2\theta}{ds^2} = -F\cos(\alpha - \theta)$$

Multiplying by $d\theta/ds$ and integrating:

$$\frac{EI}{2}\left(\frac{d\theta}{ds}\right)^2 = F\sin(\alpha - \theta) + C_1$$

But when $\theta = \alpha$, $d\theta/ds = 0$; therefore $C_1 = 0$.

Then:

$$ds = -K\frac{d\theta}{\sin^{1/2}(\alpha - \theta)} \ldots (13)$$

$$\text{where } K = \left(\frac{EI}{2F}\right)^{1/2}.$$

The negative root is used because

$$\sin^{1/2}(\alpha - \theta) > 0,\ \left(\frac{EI}{2F}\right)^{1/2} > 0, \text{ and } \frac{ds}{d\theta} < 0$$

Expressions for x_a and y_a can be found from Eq. 13:

$$x_a = K\int_0^\alpha \cos\theta\sin^{-1/2}(\alpha - \theta)d\theta$$

$$y_a = K\int_0^\alpha \sin\theta\sin^{-1/2}(\alpha - \theta)d\theta$$

To integrate the right-hand members let $u = \alpha - \theta$. The equations then become:

$$x_a = K(2\cos\alpha\sin^{1/2}\alpha + U\sin\alpha)$$

$$y_a = K(2\sin^{3/2}\alpha - U\cos\alpha) \quad \ldots (14)$$

where $U = \int_0^\alpha \sin^{1/2} u\, du.$

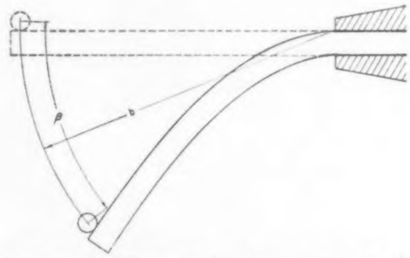

Fig. 3—Position of Cantilever Specimen in Olsen Stiffness Tester.

Similarly expressions for x and y can be obtained. Using these values it can be shown that:

$$(x\cos\alpha + y\sin\alpha) = 2K\sin^{1/2}(\alpha - \theta)$$

Now since $K > 0$, and $\sin^{1/2}(\alpha - \theta) > 0$, for $0 < \alpha \leqq \pi$, then $(x\cos\alpha + y\sin\alpha) > 0$, for all values of α between 0 and π.

Referring now to Fig. 2, the Olsen Stiffness Tester is designed to measure the moment M_a of the force F about point A and the angle of deflection β. The distance b, or $\overline{OA}$, is the span length. Since b and β are here chosen with respect to the elastic curve, and since span and deflection on the tester are taken with respect to a test specimen that has thickness as shown in Fig. 3, condition 5 (see above) is imposed.

It now follows that:

$$M_a = F(x_a\cos\alpha + y_a\sin\alpha) \ldots (15)$$

Substituting x_a and y_a of Eq. 14 in Eq. 15 and solving for F:

$$F = \frac{M_a^2}{2EI\sin\alpha}$$

Then

$$K = \frac{EI}{M_a}\sin^{1/2}\alpha \ldots\ldots\ldots (16)$$

Then y_a of Eq. 14 becomes:

$$y_a = \frac{EI}{M_a}\sin^{1/2}\alpha(2\sin^{3/2}\alpha - U\cos\alpha)$$

But from Fig. 2:

$$y_a = b\sin\beta = b\sin\left(\tan^{-1}\frac{y_a}{x_a}\right)$$

Combining the last two equations and solving for E:

$$E = \frac{pWb}{NI} \ldots\ldots\ldots\ldots (17)$$

TABLE I.—VALUES OF N AS A FUNCTION OF ANGULAR DEFLECTION, β.

β, deg.	N	β, deg.	N	β, deg.	N
1	0.052	31	1.51	61	2.36
2	0.105	32	1.55	62	2.37
3	0.157	33	1.59	63	2.38
4	0.209	34	1.63	64	2.39
5	0.261	35	1.67	65	2.39
6	0.313	36	1.71	66	2.40
7	0.365	37	1.75	67	2.40
8	0.417	38	1.78	68	2.40
9	0.469	39	1.82	69	2.41
10	0.520	40	1.85	70	2.41
11	0.571	41	1.89	71	2.40
12	0.622	42	1.92	72	2.40
13	0.672	43	1.95	73	2.40
14	0.723	44	1.99	74	2.39
15	0.773	45	2.02	75	2.38
16	0.822	46	2.05	76	2.37
17	0.872	47	2.07	77	2.36
18	0.920	48	2.10	78	2.34
19	0.969	49	2.13	79	2.33
20	1.02	50	2.15	80	2.31
21	1.06	51	2.18	81	2.29
22	1.11	52	2.20	82	2.27
23	1.16	53	2.22	83	2.24
24	1.20	54	2.24	84	2.22
25	1.25	55	2.26	85	2.19
26	1.30	56	2.28	86	2.16
27	1.34	57	2.30	87	2.12
28	1.38	58	2.32	88	2.09
29	1.43	59	2.33	89	2.04
30	1.47	60	2.34	90	2.00

since $M_a = pW$, and where N is a function of α:

$$N = [\sin\alpha(4\sin\alpha + U^2)]^{1/2} \ldots (18)$$

But since N, U, and β are each functions of the common parameter α, then N must be a function of the angle of deflection β.

For different values of $0 < \alpha < \pi$, corresponding values of U were computed by conversion to elliptic integrals, values of $\beta = \tan^{-1}(y_a/x_a)$ were calculated, and also values of N by Eq. 18. Values of $N(\beta)$ are given in Table I.

It should be noted that Eq. 1 can also be derived from Eq. 11 but only on the basis of a further assumption. Since:

$$\rho = \left|\frac{[1 + (y')^2]^{3/2}}{y''}\right|$$

and if it is assumed that the beam will suffer small deflections only so that $y' = dy/dx$ can be considered negligible, then Eq. 11 can be written:

$$M = -Fx = EIy''$$

from which Eq. 1 can be readily derived.

It will be seen that Eqs. 1 and 17 differ only in one term. For the sake of comparison, some values of 3β and $N(\beta)$ are given:

β, deg.	3β, radians	N
0	0	0
10	0.524	0.520
20	1.05	1.02
30	1.57	1.47
40	2.09	1.85
50	2.62	2.15
60	3.14	2.34
70	3.67	2.41
80	4.19	2.31
90	4.71	2.00

With respect to Eq. 17, Eq. 1 would thus give values of modulus that are low, especially at large angular deflections.

[4] Timoshenko considers a similar problem in his "Theory of Elastic Stability," McGraw-Hill Book Co., p. 69 (1936).

TABLE II.—VALUES OF E FOR A RUBBER COMPOUND UNDER DIFFERENT TEST CONDITIONS.

Specimen Width, w, in.		1/4											1										
Nominal Specimen Thickness, t, in.		1/16	1/8		3/16				1/4				1/16	1/8			3/16				1/4		
Pendulum Weight, W (as calibrated)		0.1	0.1	0.5	0.5	1.0	2.0	3.0	0.5	1.0	2.0	3.0	0.5	0.5	1.0	2.0	2.0	3.0	5.0	6.0	2.0	5.0	6.0
Test Span, in.	Angular deflection, β, deg.																						
1	10	4040	2420	2180	1730	1570	..	1510	..	1380	..	1490	4270	2650	2080	2080	..	1640	..	1640	..	..	1660
	20	2980	1930	1850	1440	1410	..	1340	..	1210	..	1260	3270	2000	1760	1590	..	1460	..	1280	..	..	1380
	30	2700	1710	1710	1410	1350	..	1330	..	1190	..	1230	2830	1800	1630	1590	..	1390	..	1320	..	..	1330
	40	2530	..	1630	..	1380	..	1380	..	1220	..	1250	2700	1750	1620	1560	..	1380	..	1340	..	..	1380
	50	2390	..	1640	..	1430	..	1460	..	1300	..	1360	2580	..	1650	1590	..	..	..	1420	..	..	1440
	60	2500	..	1780	..	1470	..	1550	..	..	..	1430	2610	..	1720	1690	..	..	..	1540	..	..	1540
	70	2520	..	1880	..	..	..	1670	..	..	..	1530	2650	..	1820	1790	..	..	..	1640	..	..	1660
	80	2830	..	2070	..	..	..	1910	..	..	..	1750	2890	..	2030	2030	..	..	..	1870	..	..	1890
	90	3390	..	2460	..	..	..	2250	..	..	..	2150	3330	..	2370	2430	..	..	..	2120	..	..	2150
2	10	..	..	3230	..	2100	2100	1890	1940	1930	1940	..	6410	4620	3570	4200	2370	..	2690	..	2230	2230	..
	20	..	..	2590	..	1710	1710	1280	1620	1640	1640	..	4900	3270	2780	3000	1970	..	2120	..	1870	1920	..
	30	..	..	2120	..	1560	1560	1230	1480	1520	1520	..	4160	2820	2530	2530	1840	..	1900	..	1770	1820	..
	40	..	..	1950	..	1500	1530	1150	1440	1450	1450	..	3900	2600	2420	2360	..	..	1850	..	..	1800	..
	50	..	..	1900	..	1500	1520	1140	1400	1460	1460	..	3620	2490	2340	2340	..	..	1880	..	..	1850	..
	60	..	..	1950	..	1540	1540	1190	..	1530	1530	..	3560	..	2380	2430	..	..	1910	..	..	1920	..
	70	..	..	1990	..	1610	1630	1220	..	1600	1620	..	3460	..	2490	2540	..	..	2030	..	..	2040	..
	80	..	..	2180	..	1700	1800	1350	..	1710	1790	..	3610	..	2740	2740	..	..	2180	..	..	2260	..
	90	..	..	2640	..	1990	2130	1560	..	2070	2070	..	4170	..	3170	3170	..	..	2590	..	..	2610	..

Experimental Results

Measurements were obtained on the Olsen Stiffness Tester, 6 in.-lb. capacity, for four rubber compounds under a number of different test conditions of load, deflection, and span ($\frac{1}{4}$, $\frac{1}{2}$, 1, 2 in.) and for several different specimen widths ($\frac{1}{4}$, $\frac{1}{2}$, 1 in.) and thicknesses (nominally $\frac{1}{16}$, $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$ in.). The procedure of A.S.T.M. Method D 747 – 43 T was followed, with the exceptions that the bending plate was replaced by a pin, of $\frac{1}{8}$-in. diameter, free to rotate about its axis, and that load scale readings were taken for every 10 deg. of deflection. All tests were run to full range either on the load or deflection scales unless the sample movement was obstructed by the framework of the tester.

Test specimens were conditioned to room temperature, and all tests were performed at room temperature. Specimens were in approximately the same physical state, from the standpoint of mechanical conditioning, at the start of each test run, having been subjected to at least one initial bending cycle.

Values of modulus of elasticity E were then computed by Eq. 17. These are given, in part, for one of the compounds in Table II.

It will be seen, even from this sampling of data, that E is not independent of test conditions and specimen dimensions. This was also found to be true for the other three compounds. For any one specimen size and set of test conditions, as the sample was deflected from 0 to 90 deg., a decrease followed by an increase in E was observed in most cases. In general it was found that:

(*a*) The greater the span the larger is E.

(*b*) The greater the specimen thickness the smaller is E.

(*c*) There was little variation in E with specimen width.

(*d*) E was approximately constant with different pendulum weights.

A statistical study of the test results was not made since it was considered to be beyond the scope of the paper. The fact that definitely systematic variations of E with the different test parameters were observed for four different rubber compounds, was considered sufficient evidence that modulus of elasticity E as computed by Eq. 17 is not a fundamental property. The cause for this can most probably be attributed to the assumptions that had to be made in the theoretical approach in order to arrive at a practical formula.

Summary and Conclusions

The theory of the bending of cantilever beams under large deflections was developed in some detail. Necessary conditions and assumptions were stated. No practical method was found for converting the measurements obtained in the A.S.T.M. stiffness test into a fundamental measure of elasticity for rubber. For this reason, as well as that given under A.S.T.M. Method D 747 – 43 T, namely, that the test does not distinguish between elastic and plastic properties, it is recommended that, for rubber, the test method be considered as a relative one only. Its main value thus seems to lie in routine production control testing, rather than in fundamental research.

It is further suggested that modulus of elasticity E be computed by Eq. 17, since it is based on one less assumption than Eq. 1.

An attempt is currently being made by the author to obtain a fundamental measure of certain elastic properties of rubber by means of a bending test that is still under development. Results of this investigation to date are encouraging.

Acknowledgment:

The author is indebted to the Gates Rubber Co. for the privilege of publishing this paper, and wishes to thank Mr. James Hurry for valuable suggestions, and Mr. Marion Fackler for obtaining the great number of experimental measurements.

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A Polarographic Method for the Direct Determination of Aluminum Oxide in Portland Cement

By C. L. Ford[1] and Lorrayne LeMar[2]

In the usual procedure for the chemical analysis of portland cement, aluminum oxide (Al_2O_3) is not determined directly but "by difference" by subtracting the separately determined amount of iron oxide (Fe_2O_3) from the total amount of oxides obtained by precipitation with ammonium hydroxide. The A.S.T.M. Standard Methods of Chemical Analysis of Portland Cement (C 114 – 47)[3] provides, as a further "by difference" correction, that in case of dispute the amount of aluminum oxide as determined above shall be further corrected for the phosphoric anhydride (P_2O_5) and titanium dioxide (TiO_2) which are always present, sometimes in amounts in excess of 0.7 per cent. The first of the above "by difference" procedures is inaccurate and the second requires additional analyses and a considerable amount of time.

The development of the polarograph by Heyrovsky and Shikata (**1**)[4] and its subsequent application to the analysis of a variety of materials suggested that a method might be developed for the direct determination of aluminum oxide in portland cement. Such a method would reduce the time required for the numerous chemical separations involved in the "by difference" determination of aluminum oxide.

Apparatus

The instrument used in this study was an E. H. Sargent and Co. Polarograph, Model XI. The electrolysis cells were of the type illustrated in Fig. 1. The method of operation and characteristics of the instrument were described in literature furnished by the manufacturer. Further information was obtained from Kolthoff and Lingane's "Polarography" (**2**), Müller's "Polarographic Method of Analysis" (**3**), and other literature. Some difficulty was experienced from vibration, but this was considerably reduced by mounting the instrument on a heavy steel plate. Temperature control was attained by placing the electrolysis cell in a shallow pan of water whose temperature was maintained constant by circulating the water from the pan through a copper coil in a constant temperature bath.

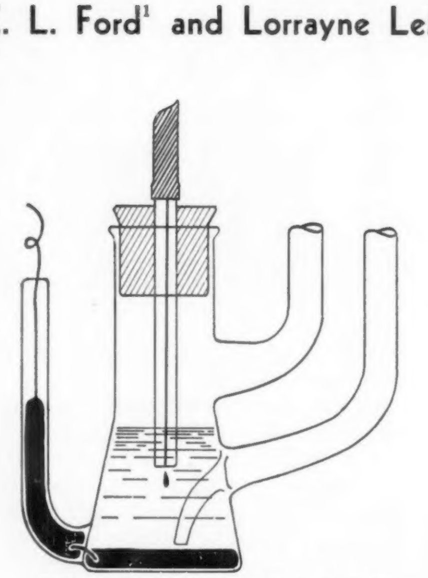

Fig. 1.—Heyrovsky Electrolysis Cell.

Preliminary Studies

General:

Since very little has been reported in the literature on the determination of aluminum polarographically, and nothing at all on its determination in portland cement, considerable experimental work was necessary to determine the effect of various factors. The study of some of these factors involving preparation of standard and sample solutions and interpretation and calculation of results will be described below.

Standards of Comparison:

The selection of a suitable standard solution of aluminum was a basic consideration. It was at first thought that aluminum chloride solutions prepared from pure aluminum wire could be used. These solutions were partially satisfactory, but it became apparent that standard solutions must contain not only aluminum but also the other components ordinarily found in solutions of cement. A solution of a laboratory-prepared aluminum-free cement to which standard aluminum chloride solutions were added proved satisfactory, but because of the limited availability of such a cement, National Bureau of Standards argillaceous limestone No. 1a and P.C.A. check cement sample No. 1 were later adopted. The latter is a mixture of four brands of commercial cement which has been carefully analyzed chemically by several analysts in the Portland Cement Association Laboratories.

Supporting Electrolytes:

The proper choice of a suitable supporting electrolyte was necessary to secure good polarograms. Potassium chloride (**4**), lithium chloride (**5**), lithium and barium chloride (**6**), and barium chloride (**2**) are mentioned in the literature and were tried in this investigation. Of these, barium chloride (with potassium chloride present due to the neutralization process) was found most satisfactory for the analysis of cement for aluminum. Barium chloride was effective as a maxima suppressor, making unnecessary the use of added suppressors such as gelatin.

Preparation of Solutions:

Proper preparation of the cement samples and standard solutions was found to be an important factor in obtaining satisfactory polarograms. The problems involved included selection of suitable sample size and final approximate concentration of aluminum, chemical separations required, and selection and adjustment of a suitable pH value.

In the earlier tests, sample sizes were chosen which gave a final concentration of 1.0 g. of cement per liter, or for a cement containing 5.0 per cent Al_2O_3, 0.05 g. of Al_2O_3, per liter or an approximately 0.0005 M solution. At first chemical separations were limited to the removal of silica by evaporation with hydrochloric acid. The rapid ammonium chloride method for silica could not be used because the ammonium ion thus introduced caused poor aluminum curves. The strongly acid solution resulting from the separation of silica by hydrochloric acid required, even after the removal of a large amount of the acid by evaporation, an excessive amount of alkali to attain a suitable pH for the aluminum determination.

In an effort to avoid the above difficulties and reduce the time, many tests were made to develop a procedure which did not require separation of silica. However, no consistently satisfactory method was discovered. The

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[3] 1947 Supplement to Book of A.S.T.M. Standards, Part II, p. 5.
[4] The bold face numbers in parentheses refer to the list of references appended to this paper.

presence of silica appeared to cause low aluminum values, poor curves and poor reproducibility. It is believed that some of the aluminum combined with silica to form compounds which were not reduced at the dropping mercury electrode.

The best results have been obtained by using higher concentrations and not only removing the silica but separating and then redissolving the ammonium hydroxide group in sufficient liquid to give a solution containing about 0.125 g. of Al_2O_3 per liter or an approximately 0.00125 *M* solution. Separation of the ammonium hydroxide group made possible the use of the ammonium chloride method for silica separation. By using this shorter silica procedure, the time required for the separation of both silica and the ammonium hydroxide group was not much greater than was previously required for the separation of silica only. The procedure as developed will be described later in more detail.

pH of Solutions:

Selection of the optimum pH value was somewhat of a compromise. On the one hand it was necessary that the pH of the solutions be sufficiently low to prevent precipitation of aluminum. On the other hand too low a pH was objectionable because hydrogen ion caused serious interference since it is reduced at the dropping electrode at a voltage somewhat lower but close to that at which aluminum is reduced. It was impossible entirely to eliminate hydrogen-ion interference without causing low aluminum results. However, at a pH of about 3.6 the interference was relatively small and good aluminum results were obtained. Also at this pH iron was completely precipitated and its interfering effect was removed. It was found necessary, however, to allow the solution to stand for several hours, or better, overnight to effect complete precipitation of iron. At a pH above approximately 3.70 the aluminum values were low although theoretically aluminum does not begin to precipitate until a pH of approximately 5.0 is reached.

Number of Polarograms:

Other factors studied included the number of polarograms to be recorded for a given solution and the methods of comparison of polarogram heights obtained with sample and standard solutions. For the purpose of this investigation two or more polarograms were usually made, although as discussed later, good results may be expected from a single polarogram, provided, of course, that all parts of the analysis are carried out with due care. In the earlier part of the study three separate polarograms were made of each solution. Later, to save time in developing photographic paper, the three polarograms were superimposed. This in turn introduced errors due to single measurements. As a final compromise two separate polarograms were made and the heights averaged.

Interpretation of Data:

The study of methods of comparison of polarogram heights obtained with sample and standard solutions was limited to two suggested by Lingane and Kolthoff (**2**), namely, standard additions and standard curves. In the standard addition method, polarograms of a known volume of sample solutions were first made, then the solution was diluted with a known volume of a standard solution and additional polarograms were made. From measurements of the curve heights of both sets of polarograms, aluminum percentages could be calculated. This method was subject to too many errors and was abandoned.

The standard curve method was used extensively, some of the results obtained being presented later. In this method curves were prepared by plotting polarogram curve heights obtained from a series of standard solutions of varying concentrations. Aluminum oxide percentages were read directly from the standard curve. Since the curve was very nearly a straight line, it was found practical to use a single standard concentration ("single point" standard) and average the results of several polarograms from several solutions for computation purposes.

Method as Developed

The most satisfactory procedures for the various steps in the polarographic determination of Al_2O_3 in portland cement have been combined into a working method which will be described briefly below.

Preparation of Solutions of Unknowns:

Solutions of unknown cements were prepared as follows: Silica was removed from a 0.500-g. sample of cement by the ammonium chloride method (A.S.T.M. Methods C 114 – 46, Section 33).[5] The silica was volatilized with hydrofluoric acid in platinum. The ammonium hydroxide group was separated by double precipitation from the filtrate from the silica separation, and placed in the platinum vessel containing the residue from the silica volatilization, then dried and ignited. The ignited precipitate was fused with a small amount of sodium carbonate, dissolved in hydrochloric acid, (1:10,) diluted to about 60 ml., and neutralized carefully first with 1.0 *N* and finally with 0.1 *N* potassium hydroxide to a pH of 3.60 ± 0.03 using a Beckmann Model G pH meter. During the addition of the potassium hydroxide, the solution was stirred vigorously. Then 30 ml. of 0.5 *M* barium chloride solution were added and the volume was adjusted to the mark in a 200-ml. volumetric flask. Final pH was between 3.55 and 3.70. The cement concentration of the solution was 2.5 g. per liter. For a cement containing 5.0 per cent Al_2O_3, this represented 0.125 g. of Al_2O_3 per liter or an approximately 0.00125 *M* solution.

Preparation of Standard Solutions:

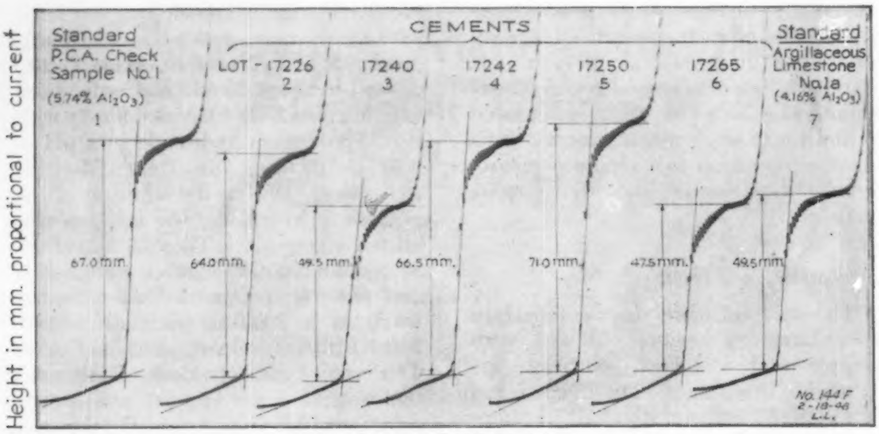
Solutions of standard materials were prepared as follows:

1. Standard solutions based on pure aluminum wire (Baker's analyzed 99.99 per cent Al) as the source of aluminum, and a laboratory-prepared aluminum-free cement to supply the other elements commonly found in cement. A series of standard solutions equivalent to from 1 to 8 per cent Al_2O_3 in cement were prepared by adding varying amounts of a solution of known concentration of aluminum in hydrochloric acid to solutions of the aluminum-free cement prepared as described above. The aluminum chloride solution was added to the filtrate from the silica separation before the separation of the ammonium group.
2. Standard solutions of National Bureau of Standards argillaceous limestone No. 1a: A range of sample weights was selected which would have Al_2O_3 contents equivalent to from 1.66 to 6.66 per cent Al_2O_3 in cement solutions containing 2.5 g. of cement per liter. After a preliminary ignition at 1000 C. to make the limestone acid-soluble, the preparation was similar to that described above for cements.

Procedure:

The solutions of both standards and cements were electrolyzed in the cells at a constant temperature of 25.0 ± 0.3 C. After removal of oxygen by bubbling nitrogen gas through the solutions, two or three polarograms were recorded for each sample. In part of the test, three polarograms were superimposed on each other. In other tests two single polarograms were recorded separately and the curve heights were averaged. For most of the solutions two or more tests were made on different days using two or more solutions similarly prepared. A set of polarograms showing two "single

[5] Standard Methods of Chemical Analysis of Portland Cement (C 144–46) 1946 Book of A.S.T.M. Standards, Part II, p. 36.



$$\% Al_2O_3 = \frac{\text{Height of curve from solution of cement}}{\text{" " " " " standard}} \times \% Al_2O_3 \text{ for standard}$$

Example – % Al_2O_3 for Cement Lot 17226 using Standard No. 1 $= \frac{64.0 \text{ mm.}}{67.0 \text{ mm.}} \times 5.74 = 5.48\%$

" " " " " " " No. 1a $= \frac{64.0 \text{ mm.}}{49.5 \text{ mm}} \times 4.16 = 5.38\%$

Fig. 2.—Polarograms of Cements and Standards.

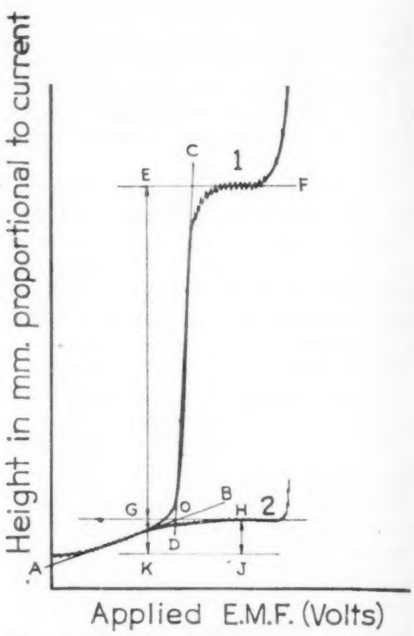


Fig. 3.—Method of Measuring Diffusion Current of Aluminum Ion.

(1) Residual current of a solution containing aluminum from portland cement with barium chloride as supporting electrolyte. (2) Residual current of a similar solution containing no aluminum. The corrected diffusion current is measured along the line *E–G*.

point" standards and five cements is shown in Fig. 2. The curves of the two standards, P.C.A. check sample No. 1 and argillaceous limestone No. 1a, are shown in polarograms Nos. 1 and 7, respectively. The curves of the cements are shown in the intermediate polarograms. In this case only one polarogram was made from each solution. The method of measurement of curve heights is illustrated in Fig. 2 and in more detail in Fig. 3.

Interpretation of Results:

Although the method of measurement of curve heights is partly empirical, it is based on theoretical considerations. The height of polarographic curves or waves is generally proportional to the current passing through the cell (diffusion current) which in turn is proportional to the concentration in solution of the reducible ion being investigated. The diffusion current is obtained by correcting the limiting current for the residual current.

Various methods have been suggested for the actual graphical measurement of the diffusion current (**2, 3, 7**). None of these were exactly adaptable to this investigation, however, since the rise of the portion of the curve (line *AB*, Fig. 3) immediately preceding the reduction of aluminum was caused by the reduction of hydrogen and the slope was a function of the concentration of the latter. The method adopted and illustrated in Fig. 2 was based on the more detailed graph shown in Fig. 3. Many "blank" determinations were made using both aluminum chloride solution and solutions of aluminum-free cement, and in all of these the residual current for aluminum (which is also the limiting current for hydrogen) was approximately constant and gave a nearly horizontal curve (Fig. 3, curve 2). In practice it is not practical to make and use a diffusion current curve for each aluminum curve since the heights *GK* and *HJ* of the hydrogen curves are not usually equal as are those shown in Fig. 3 but vary with slight differences in pH. It has been observed, however, that by drawing the lines *AB* and *CD*, an intersecting point *O* is located which is in the same horizontal plane as the residual current curve. It was possible therefore to draw the horizontal line *GH* to represent the residual current curve.

The limiting current for aluminum is marked by the upper portion or plateau of the wave. This plateau is approximately parallel to the diffusion current wave and may therefore be used for the graphical determination of the curve height by drawing the line *EF*. In the case of curves (not illustrated) for aluminum chloride solutions the horizontal portions are longer and better defined. The sharp rise following the aluminum plateau is caused by the beginning of the barium wave resulting from the supporting electrolyte which is present in large excess.

Unfortunately the plateaus were not always sharply defined as shown in the polarograms of cement Nos. 17,226 and 17,240 (Fig. 2). However, careful examination shows that even in these cases the peaks caused by two or more oscillations of the galvanometer are approximately at the same level, and at the same time the extent of oscillation reaches a minimum. The horizontal lines were drawn through approximately the middle of the oscillations which were at the same level. In a few instances (not illustrated) where the oscillations failed to level off at all, it was necessary to repeat the tests.

The standard curve obtained by plotting curve heights obtained with the series of aluminum chloride solutions of varying concentration with an aluminum-free cement base is shown in Fig. 4. The standard curve plotted from a similar series of argillaceous limestone solutions is shown in Fig. 5.

It will be noted that from 2 per cent to about 6.5 per cent Al_2O_3, which covers the usual portland cement range, the curves are nearly straight lines which intercept near the zero point. In view of the straight-line relationship it was found possible to use a "single point" standard solution of the argillaceous limestone to calculate by proportion the Al_2O_3 values of the cements. As another "single point" standard, P.C.A. check sample No. 1 with an Al_2O_3 content of 5.74 per cent was prepared in only one concentration which was the same as that of the samples, namely, 2.5 g. per liter.

Time Requirements:

The elapsed time required for complete preparation and analysis of six solutions carried along together was three days. The analyst's actual working time was about twelve hours. On the first day the silica was separated and volatilized and the ammonium hydroxide group was double precipitated

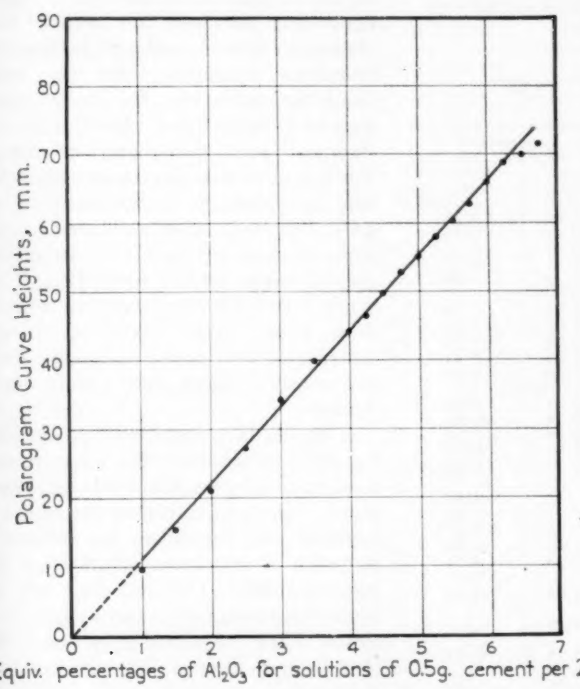


Fig. 4.—Standard Curve Based on Standard Aluminum Chloride Solutions Added to Solutions of Aluminum-free Cement.

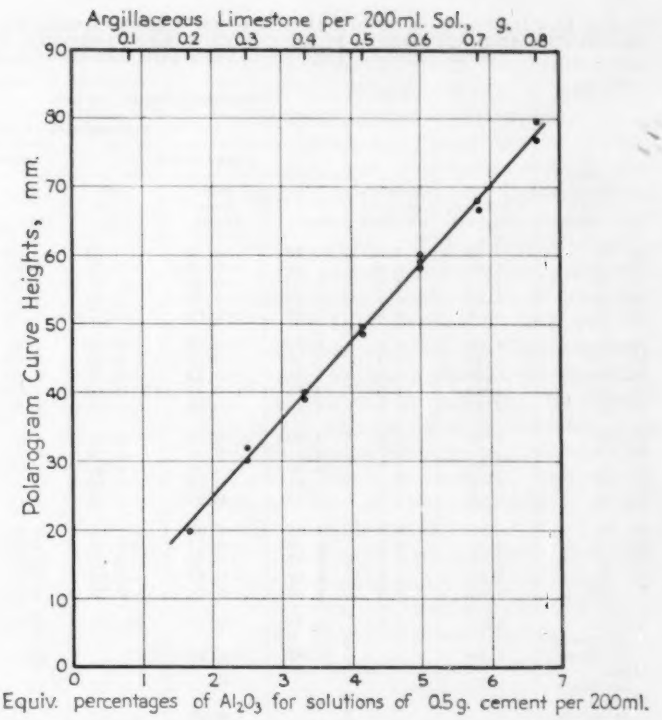


Fig. 5.—Standard Curve Based on Bureau of Standards Argillaceous Limestone Sample No. 1a.

and the filter paper dried and charred. The second day the precipitate was ignited, fused with sodium carbonate, and dissolved in acid. The pH was then adjusted and the solution made up to volume. It was necessary to allow the solution to stand overnight at this stage to effect complete separation of iron and to allow any aluminum to redissolve that might have been precipitated by the too rapid addition of alkali. The third day the pH was checked and the polarograms were recorded. It was then possible to develop and dry the photographic paper and interpret the results the same day, but it was usually more convenient to allow the paper to dry overnight. The actual measurement and calculation of aluminum oxide percentages required relatively little time.

The time required for the aluminum determination may be considerably reduced if it is made as a part of the chemical analysis of cement according to A.S.T.M. Method C 114–47 provided, however, that the ignited ammonium hydroxide group precipitate (Section 9 (*c*)) is used for this purpose instead of for the determination of the trace of silica contained therein (Section 9 (*d*) and (*e*)).

Discussion of Results

About fifty portland cements have been analyzed for aluminum polarographically, but only 27 have been tested sufficiently to be included in this report. Of the 27, 21 were cements used in an investigation entitled "Long-Time Study of Cement Performance in Concrete" (**8**), 5 were miscellaneous portland cements that in the earlier part of this study caused considerable difficulties in attempts to determine the aluminum content with the polarograph, and one was the previously mentioned P.C.A. check sample No. 1. The value of this last cement as a secondary standard was also studied. The "Long-Time Study" cements are listed in Table I with the aluminum content as determined chemically and spectrographically. The chemical and polarographic analyses of the miscellaneous cements are shown in Table II. The chemical analyses were made in this laboratory. The aluminum values shown were determined "by difference," that is, by first determining the total of the oxides precipitated by ammonium hydroxide; then subtracting the iron oxide, titanium dioxide, and phosphoric anhydride contents as determined separately. The spectrographic analyses were made by Helz and Scribner (**9**) at the National Bureau of Standards. Most of the polarographic values are the average results of three or more determinations. The values for the five miscellaneous cements are the average of 10 to 20 polarograms.

Aluminum oxide values for all the 21 "Long-Time Study" cements were calculated by comparison with a curve prepared from standard aluminum chloride solutions. The last three of them were also calculated by the later developed method of comparison with the standard solutions of argillaceous limestone and of cement. These last three are also shown in Table II.

Calculations based on the aluminum chloride standard curve (but not on other standards) showed certain anomalous results in that the values so obtained for the cements were nearly all about 0.2 per cent below the chemical analysis values. Likewise when the aluminum chloride standard curve was used to calculate the Al_2O_3 content of argillaceous limestone No. 1a, a value of 3.92 per cent was obtained as compared with the certified value of 4.15 per cent. The low values are at least partially explained by the presence of a small amount of aluminum oxide in the supposedly aluminum-free cement used as a base for the aluminum chloride solutions. This would cause the standard curves to be too high with resultant too low calculated values for the cements being tested. Chemical analysis "by difference" of the aluminum-free cement indicated that it contained 0.1 to 0.2 per cent Al_2O_3. Spectrographic test of a sample showed 0.07 per cent Al_2O_3 (0.04 per cent Al). As a result of this apparent difference of about 0.2 per cent in the standards, 0.2 per cent was arbitrarily added as a correction to the cal-

TABLE I.—COMPARISON OF POLAROGRAPHIC VALUES BASED ON SOLUTIONS OF PURE ALUMINUM AND ALUMINUM-FREE CEMENTS AS STANDARDS, WITH CHEMICAL AND SPECTROGRAPHIC ANALYSES FOR ALUMINUM OXIDE.

Long-Time Study Cement	Aluminum Oxide, per cent							
			Polarographic Values					
			Uncorrected			Corrected by 0.2 per cent		
	Chemical Values[a]	Spectrographic Values	Amount	Diff. from Chem.	Diff. from Spec.	Amount	Diff. from Chem.	Diff. from Spec.
No. 11......	5.64	5.3	5.43	−0.21	+0.13	5.63	−0.01	+0.33
No. 12......	5.81	5.4	5.66	−0.15	+0.26	5.86	+0.05	+0.46
No. 13......	4.72	4.6	4.53	−0.19	−0.07	4.73	+0.01	+0.13
No. 14......	4.72	4.5	4.47	−0.25	−0.03	4.67	−0.05	+0.17
No. 15......	5.36	5.6	5.33	−0.03	−0.27	5.53	+0.17	−0.07
No. 16......	4.68	4.9	4.72	+0.04	−0.18	4.92	+0.24	+0.02
No. 17......	5.42	5.4	5.10	−0.32	−0.30	5.30	−0.12	−0.10
No. 18......	6.09	5.8	5.66	−0.43	−0.14	5.86	−0.23	+0.06
No. 21......	4.02	4.0	3.84	−0.18	−0.16	4.04	+0.02	+0.04
No. 22......	4.52	4.8	4.45	−0.07	−0.35	4.65	+0.13	−0.15
No. 23......	4.30	4.7	4.09	−0.21	−0.61	4.29	−0.01	−0.41
No. 24......	4.79	4.7	4.51	−0.28	−0.19	4.71	−0.08	+0.01
No. 25......	4.56	4.7	4.30	−0.26	−0.40	4.50	−0.06	−0.20
No. 31......	5.00	5.5	4.81	−0.19	−0.69	5.01	+0.01	−0.49
No. 33	5.16	5.4	4.92	−0.24	−0.48	5.12	−0.04	−0.24
No. 34......	3.92	4.5	3.84	−0.08	−0.66	4.04	+0.12	−0.46
No. 41......	4.59	4.2	4.28	−0.31	+0.08	4.48	−0.11	+0.28
No. 42......	2.81	2.8	2.87	+0.06	+0.07	3.07	+0.26	+0.27
No. 43......	4.85	5.1	4.42	−0.43	−0.68	4.62	−0.23	−0.48
No. 43A.....	3.62	3.6	4.23	−0.38	−0.36	3.44	−0.18	−0.16
No. 51......	3.07	3.3	2.91	−0.16	−0.39	3.11	+0.04	−0.19
Argillaceous limestone..	4.16	...	3.92	−0.24	....	4.12	−0.04	....
Mean deviation..	....	...	....	0.21	0.31	....	0.10	0.23
Maximum deviation..	....	...	....	−0.43	−0.69	....	+0.26	−0.49

[a] Corrected for TiO_2 and P_2O_5.

culated values. The corrected polarographic results will be observed in the table to be generally in good agreement with the chemical analysis. It is not claimed that the corrected values are more nearly true values but only that they conform more closely to the values obtained chemically. It is admittedly possible that the uncorrected polarographic values are closer to the true values.

It is of interest to note that the corrected polarographic values for those cements, namely, Nos. 15, 16, 22, 34, and 41, the aluminum contents of which vary more than 0.1 per cent from the chemical values, are closer to the spectrographic values than are the chemical values. The large discrepancy (−0.26 per cent) for Cement No. 42 is not explainable in any way. The variation for cements Nos. 43 and 43A (−0.23 and −0.18 per cent) from both the chemical and spectrographic values was partially confirmed by later comparison with argillaceous limestone standards. This part of the study shows that when an aluminum-free cement is available, pure aluminum is a good basic standard, provided enough samples are analyzed to establish the correction necessary to correlate with chemical values. Four out of the six other cements which were also compared with $AlCl_3$ standards showed poor agreement, due presumably to deterioration of the dropping electrode. The electrode was replaced, but due to variations in the characteristics of the individual electrodes, it was not practicable to compare subsequent curves with standard curves made with the old electrode.

The Al_2O_3 results obtained for three of the "Long-Time Study" cements, five miscellaneous cements, and the P.C.A. check cement as calculated on the basis of standard solutions of both argillaceous limestone and the check cement are also shown in Table II. The results for the "Long-Time Study" cements, as suggested above, showed good agreement between the results with aluminum chloride and with argillaceous limestone standards. On the other hand, the results with the check cement standards agree more closely with the chemical and spectrographic values. The five miscellaneous cements show the best agreement with the chemical results, however, when argillaceous limestone is used as standard. All polarographic values for the three "Long-Time Study" and the miscellaneous cements show a maximum deviation of only 0.21 per cent from the chemical values, and most of them agree much more closely.

It should be remembered in considering these results that this is a comparative study between chemical and polarographic methods and that the chemical analyses "by difference" are subject to as many if not more errors than the polarographic. The fact that calculations of polarographic results agree more closely when calculated from one rather than from another of different standards does not necessarily mean the results are more nearly correct. For that reason the two sets of values using argillaceous limestone values and the one set using the check sample are presented without attempting to say which is best. As a matter of convenience, a single point standard value based on several determinations is preferable to the preparation of a standard curve from a larger number of different concentrations of the standard. Although the argillaceous limestone carries a National Bureau of Standards certified value for Al_2O_3, for comparison purposes there is some justification for the use of a laboratory standard carefully analyzed chemically

TABLE II.—COMPARISON OF POLAROGRAPHIC VALUES BASED ON DIFFERENT STANDARDS.

Cement	Aluminum Oxide, per cent								
		Polarographic Values Based on Standards Indicated							
		$AlCl_3$[b]		Argillaceous		Limestone 1a		P.C.A. Check No. 1	
	Chemical Values[a]	Curve	Diff.	Curve	Diff.	Single Point	Diff.	Single Point	Diff.
No. LTS 43....	4.85	4.62	−0.23	4.68	−0.17	4.64	−0.21	4.81	−0.04
No. LTS 43A..	3.62	3.44	−0.18	3.44	−0.18	3.46	−0.16	3.58	−0.04
No. LTS 51....	3.07	3.11	+0.04	3.05	−0.02	3.07	0	3.18	+0.11
No. 17226.....	5.43	....	....	5.50	+0.07	5.41	−0.02	5.60	+0.17
No. 17240.....	4.09	....	....	4.06	−0.03	4.04	−0.05	4.19	+0.10
No. 17242.....	5.67	....	....	5.71	+0.04	5.60	−0.07	5.81	+0.14
No. 17250.....	5.97	....	....	5.97	0	5.85	−0.12	6.06	+0.09
No. 17265.....	4.11	....	....	4.09	−0.02	4.07	−0.04	4.22	+0.11
Check 1.......	5.74	....	....	5.65	−0.09	5.55	−0.19	....	....
Argillaceous limestone 1a..	4.16	....	....	....	....	....	....	4.31	+0.15
Mean deviation....	....	....	0.15	....	0.07	....	0.10	....	0.11
Maximum deviation....	....	....	....	....	−0.18	....	−0.21	....	+0.17

[a] Corrected for TiO_2 and P_2O_5.
[b] Al-free cement base; values corrected by 0.2 per cent (see Table I).

TABLE III.—COMPARISON OF CURVE HEIGHTS IN MILLIMETERS OF POLAROGRAMS MADE FROM ONE SOLUTION AND FROM DIFFERENT SOLUTIONS OF THE SAME CEMENT—NO. 17,226.

Solution	Test	Polarogram	Curve Heights, mm. (1 mm. = approx. 0.085 per cent Al_2O_3)		Deviation, mm., from	
			Individual	Average for Each Solution	Solution Average	Grand Average
A	1	1	65.5		+0.2	+1.4
		2	65.0		−0.3	+0.9
Average	..	..	....	65.3	0.3	
Maximum	..	..	....	....	−0.3	
B	1	1	65.0		+0.2	+0.9
		2	63.5		−1.3	−0.6
	2	1	65.5		+0.7	+1.4
		2	65.5		+0.7	+1.4
	3	1	64.5		−0.3	+0.4
		2	65.0		+0.2	+0.9
Average	..	..	....	64.8	0.6	
Maximum	..	..	....	....	−1.3	
C	1	1	64.5		+1.2	+0.4
		2	62.5		−0.8	−1.6
	2	1	64.0		+0.7	−0.1
		2	62.0		−1.3	−2.1
Average	..	..	....	63.3	1.0	
Maximum	..	..	....	....	−1.3	
D	1	1	63.0		−0.6	−1.1
		2	62.0		−1.6	−2.1
	2	1	63.0		−0.6	−1.1
		2	61.5		−2.1	−2.6
	3	1	64.8		+1.2	+0.7
	4	1	65.8		+2.2	+1.7
	5	1	64.2		+0.6	+0.1
	6	1	64.3		+0.7	+0.2
Average	..	..	....	63.6	1.2	
Maximum	..	..	....	....	+2.2	
E	1	1	65.0		+0.7	+0.9
	2	1	64.0		−0.3	−0.1
	3	1	64.0		−0.3	−0.1
Average	..	..	....	64.3	0.4	
Maximum	..	..	....	....	+0.7	
Grand average	..	..	64.1			0.9
Maximum deviation	..	..	....	....	....	−2.6

Probable error of individual curve heights $= 0.6745\sqrt{\frac{\Sigma(X)^2}{N-2}} = 0.84$ mm. $= 0.071$ per cent Al_2O_3.

Probable error of average $= \frac{\text{P.E. Ind.}}{\sqrt{N}} = 0.17$ mm. $= 0.014$ per cent Al_2O_3.

by the same methods which were used for other cements being analyzed polarographically. However, when a laboratory does not possess its own check sample, the National Bureau of Standards sample is to be recommended.

As stated above, the values presented in Tables I and II are the average of those obtained from a number of polarograms. The individual curve heights of the polarograms used in the study of cement No. 17226 are shown in Table III. These polarograms were obtained from five solutions prepared separately on different days. The various tests numbered 1 and 2 represent tests of the same solution placed in the electrolysis cells at different times. In many cases two polarograms were made as a part of each test. In order to find the results that could be expected if only a few polarograms were made from a given sample, the average curve heights and deviations from the mean were calculated and from these it was determined that the probable error for a single polarogram was 0.84 mm., equivalent to approximately 0.071 per cent Al_2O_3, and for the average of all determinations was 0.17 mm. or approximately 0.014 per cent Al_2O_3. The maximum deviation was 2.6 mm. or approximately 0.22 per cent Al_2O_3. This shows that the method has good precision.

Summary

1. A polarograph method has been developed for the direct determination of aluminum oxide in portland cement.

2. Interpretation of polarograms as percentages of aluminum oxide requires comparison with polarograms of standard solutions of known aluminum oxide content. The preparation and use of two types of standard solutions are presented. The second, and recommended, type of standard solutions is prepared from a material such as the National Bureau of Standards sample of argillaceous limestone No. 1a, or other material such as a reference sample of cement of known aluminum oxide content.

3. Chemical preparation of cement samples and standards requires the separation of silica and the separation and resolution of the ammonium hydroxide group. The ignited precipitate of the ammonium hydroxide group obtained in the chemical analysis of cement by A.S.T.M. Method C 114 may be used, thus reducing the time required. Careful control of pH values is essential.

4. Successful operation of the polarograph requires as much freedom from vibration as possible, temperature control of the electrolysis cell, and careful attention to the condition of the dropping electrode.

5. The method appears to give good results as compared with the usual "by difference" determination of aluminum oxide in portland cement.

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Simple Calorimeter for Specific Heat Measurements

By Roger B. Rice[1]

In the design of molds for fabricating plastic parts, and in many other problems involving the thermal properties of plastics, it is desirable to know the specific heats of these materials. The satisfactory determination of specific heat easily and quickly, using simple and inexpensive equipment, has long been a need in this and many other laboratories. The present paper describes apparatus and techniques which were developed in the Plastics Laboratory, and which permit the quantitative estimation of specific heat of many powdered solids with accuracy sufficient for design purposes, using very simple equipment and techniques. One determination can be made in about twenty minutes.

Many excellent calorimeters suited to the measurement of heat capacity of poor conductors have been described in the literature. Representative of a very common type of instrument is that designed by Wilkes and Wood[2] in which the increase in heat of a jacketed calorimeter cup is measured after introduction of a heated specimen. Hill and Bell[3] describe some recent modifications in Wilkes' design. Such an apparatus, although widely used, suffers from a number of drawbacks. It involves the use of several heating coils and thermocouples, with the complexity of their associated control and measuring equipment. It requires a separate furnace for initially raising the temperature of the specimen, with the attendant difficulty of transferring the sample from the furnace to the calorimeter. The total length of time required for a determination (5 to 8 hr.) precludes its very frequent use for regular measurements.

The familiar Bunsen[4] ice colorimeter, a modern version of which is described by Ginnings and Corruccini,[5] has many excellent features and is suited to very accurate determination, but likewise requires transfer of the specimen from an external furnace. The apparatus is fairly complex and requires skilled technique for its proper operation. The time factor in making successive determinations is also appreciable, since an ice mantel must be frozen about the specimen chamber.

A somewhat different type of calorimeter is described by Andrews.[6,7] It is spherical or cylindrical in shape, jacketed, and has numerous copper fins radiating inward to transmit heat evenly to all parts of a powdered sample. It permits determinations in a relatively short period of time (about 10 min.), and enables successive measurements to be made on the same sample without removal from the colorimeter. It is suitable for good or poor conductors. However, it, too, is a somewhat difficult piece of apparatus to construct, and requires the use of several thermocouples with their accessory equipment.

The operation of the calorimeter described herein depends upon determining the total heat capacity of the calorimeter plus the powdered sample suspended in a contact liquid, and subtracting from this value the calorimeter constant and heat capacity of the contact liquid. The operation is carried out by measuring the heat input in terms of electrical energy required to produce a measured increase in temperature of the system. The equipment and technique are discussed below.

Equipment

The present equipment is shown partially sectionalized in Fig. 1. It consists essentially of (1) a silvered Dewar flask enclosed in a protective sleeve, (2) a nichrome heating coil suspended within the flask, (3) a glass stirrer driven by a small constant speed motor, and (4) a hardwood block which holds the heater supports, stirrer, and thermometer in rigid alignment.

The flask is an ordinary 1-qt. widemouth vacuum bottle about 7 cm. inside diameter and 29 cm. tall. It is encased in a section of thin rolled plastic tubing about 10.5 cm. in diameter and 34 cm. long having a fitted wooden bottom. The annular space is filled with beeswax which was melted and poured in around the flask. The sealed tip does not touch the bottom. This construction offers a little added insulation, and provides considerable mechanical protection. This is important since any replacement of the flask necessitates recalibration of the calorimeter. The top of the flask projects about 2.5 cm. beyond the protective sheath, and fits loosely into a matching groove in the block.

The heating coil is made from No. 26 nichrome wire, wound in a helix of about 0.8 cm. in diameter, and formed in a doughnut so that it fits into the calorimeter with about 0.3 cm. clearance all around. On diametrically opposite sides of the doughnut are soldered 30-cm. lengths of No. 12 B & S gage copper wire. The ends of these pass in a snug

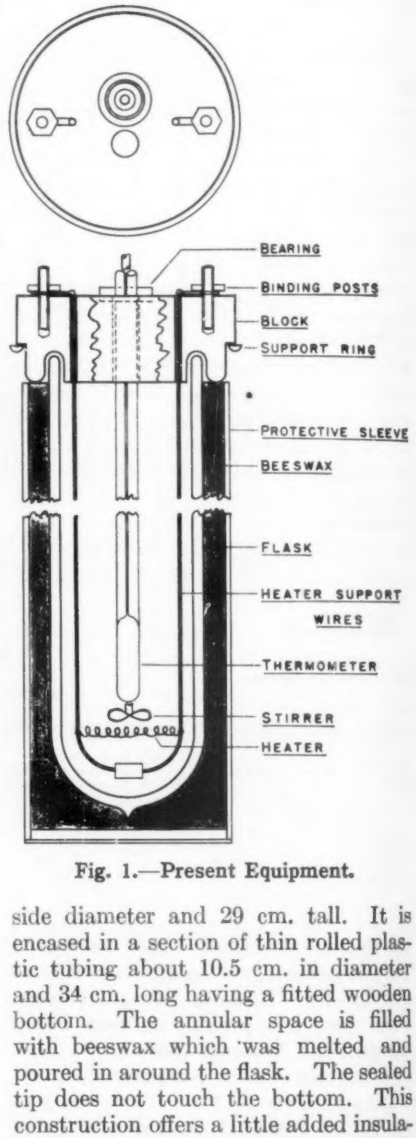

Fig. 1.—Present Equipment.

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[7] D. H. Andrews, "An Application of the Rule of DuLong and Petit to Molecules," *Journal*, Am. Chemical Soc., Vol. 50, p. 2998 (1928).

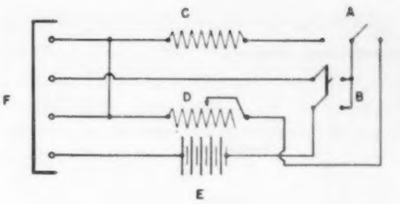
fit through holes in the wooden block and are brought out to binding posts. At the lower end of the assembly, below the coil, the wires are extended for about one inch each and are bent toward each other so the ends are separated by about 1 cm. The ends fit tightly into holes in either side of a small block of thermosetting laminate. This construction adds considerable rigidity to the heater assembly. The connecting block is streamlined so that it offers minimum hindrance to downward flow of liquid from the stirrer. The resistance of the coil (two sides in parallel) is about 2.2 ohms.

The stirrer shaft is about 60 cm. long and is formed from glass tubing 0.55 cm. in diameter, selected for straightness. The glass paddle is double-bladed, 2.5 cm. in diameter, and shaped so that its rotation causes a downward flow of liquid. At the point where the shaft passes through the wood support block it carries a small New Departure ball bearing, fitted snugly to it by means of a rubber bushing. The top of the block is recessed slightly to receive the bearing. The hole in the block through which the shaft passes is considerably larger than the shaft and is not intended for any further support of the latter. The stirrer is driven by a small constant speed motor and is coupled to the top of the shaft with a short length of heavy rubber tubing. The motor is operated independently from the rest of the electrical equipment.

The hardwood block, as has been indicated above, is drilled to take the stirrer with its ball bearing, and also the heavy copper wires which support the heating element. It also has a hole through which passes the Beckmann thermometer in a close fit. A rubber washer around the thermometer prevents its sliding through the hole when assembled, and facilitates vertical positioning of the bulb. As has also been indicated, the lower face of the block is grooved to fit loosely over the lip of the flask, and rests upon the top of the jacket.

Electrical energy is supplied to the coil by a 6-v. automobile storage battery. The input is measured with a d-c. wattmeter whose characteristics were specially designed for this particular application. A schematic diagram of the electrical circuit is shown in Fig. 2. The variable external resistance is adjusted so that its energy consumption is identical with that of the calorimeter heater.

The entire calorimeter assembly is so arranged (see Fig. 3) that the flask can be removed downward by sliding out the shelf upon which it rests without disturbing any other part of the setup. This feature greatly facilitates changing



A CALORIMETER - EXT. RESIST. SWITCH
B MAIN SWITCH
C CALORIMETER
D EXTERNAL RESISTANCE
E BATTERY
F WATTMETER

Fig. 2.—Electrical Circuit.

Fig. 3.—Entire Calorimeter Assembly.

samples, and permits all the parts of the apparatus to remain in the same relationship to each other. This is an important consideration in obtaining consistent results. The variable external resistance, special wattmeter, and control switches can be seen in the lower right-hand corner of Fig. 3.

Procedure

Determination of Calorimeter Constant:

For measurements which are to be made at approximately room temperature, a Beckmann differential thermometer is set so that room temperature reads approximately mid-scale. The thermometer is placed in its proper hole in the support block, and the apparatus entirely assembled except for the flask. The thermometer bulb, heater, and stirrer are arranged with respect to each other approximately as shown in Fig. 1. The bulb of the thermometer should be completely submerged in the calorimeter liquid when the apparatus is assembled.

About 450 g. of redistilled carbon tetrachloride or an equivalent volume of other contact medium, slightly below room temperature, is weighed to the nearest 0.1 g. into the flask. The height of the liquid is noted, and a suitable gage of stainless steel strip or heavy wire is constructed so that the distance of the liquid level from the top of the calorimeter can be reproduced accurately in subsequent calibrations and determinations.

The flask is assembled to the rest of the apparatus, and its removable shelf slid in place to support it. After making sure that the stirrer shaft runs free and the paddle blades touch no part of the coil or thermometer, the motor is started and allowed to run about five minutes. At this point the thermometer should read within the lower inch of its scale. It may be adjusted upward by throwing on the switches connecting the battery with the heating oil for a moment or two, then allowing another five minutes or more to elapse.

TABLE I.—METHOD OF COLLECTING DATA FOR TYPICAL CALIBRATION OR MEASUREMENT RUN.
"X's" denote thermometer or wattmeter readings.

Time, min.	Thermometer Readings, deg. Cent.	Wattmeter Readings, watts	Operations
0.0......	X.XXX	......	Start timer
0.5......	X.XXX		
1.0......	X.XXX		
1.5......	X.XXX		
2.0......	X.XXX		
2.5......	X.XXX		
3.0......	X.XXX		
3.5......	X.XXX	......	Main switch on—ext. resistance
4.0......	X.XXX		
4.5......	X.XXX		
5.0......	......	(XX.XX)	Switch over to calorimeter heater
5.5......	......	XX.XX	
6.0......	......	XX.XX	Main switch off
6.5......	X.XXX		
7.0......	X.XXX		
7.5......	X.XXX		
8.0......	X.XXX		
8.5......	X.XXX		
9.0......	X.XXX		
9.5......	X.XXX		
10.0......	X.XXX		
10.5......	X.XXX		
11.0......	X.XXX		
11.5......	X.XXX		
12.0	X.XXX	......	Finish readings

desirable either to dry it thoroughly before a determination or to know its free moisture content so a suitable correction can be made if desired.)

About half the quantity of contact liquid normally used in a test is introduced carefully into the tared calorimeter flask. Thirty to fifty grams of the powdered sample, depending upon its bulk density, is now weighed to the nearest 0.1 g. into the flask, followed by a quantity of contact liquid just sufficient to bring the liquid level to the same point as in the calibration. The total weight of the calorimeter and contents is determined to 0.1 g. and the weight of contact liquid obtained by difference.

The calorimeter is assembled, and the same procedure followed as described under "Determination of Calorimeter Constant." Energy input and θ are calculated as previously shown. The general expression for determination of the specific heat is as follows:

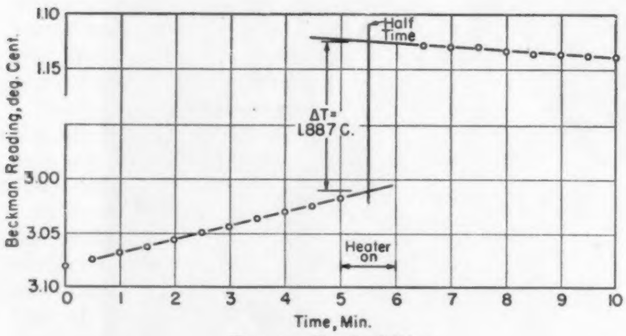


Fig. 4.—Typical Plot.

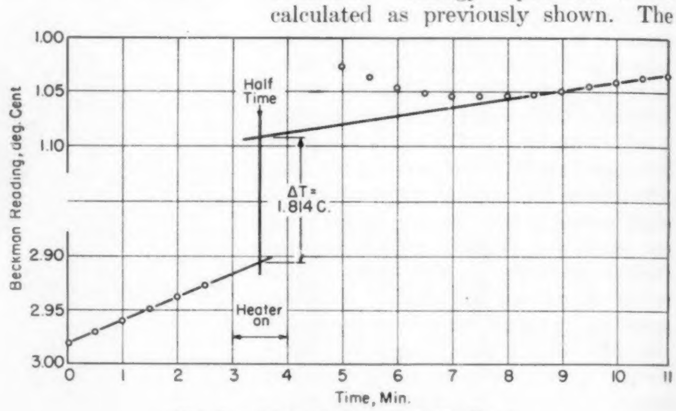


Fig. 5.—Data from One of the Runs.

The single-pole, double-throw switch is now set for the external resistance, with the main switch off, and a strict time schedule of thermometer and wattmeter readings commenced, using a stopwatch or electric timer. Table I graphically illustrates the observations made and operations performed in a typical calibration or measurement run, the "X's" indicating thermometer or wattmeter readings.

Since at the exact moment the calorimeter heater is turned on, the wattmeter needle may be shifting due to changing of the circuits, the wattage value indicated in parenthesis is derived by extrapolation of the two or more succeeding values. If the external resistance is set to exactly equal that of the calorimeter heater, and the change of circuits is accomplished rapidly, it should be possible to read this value directly. The energy input is computed by averaging the wattage figures obtained.

The net temperature increase of the system is obtained graphically by plotting on the same sheet the temperature readings obtained before and after the heating period, extrapolating the straight-line portions of each series to halftime (based on the period the heater was on) and reading the temperature increment at that point. A typical plot is shown in Fig. 4.

The general calculation for determining the calorimeter constant is as follows:

$$\frac{Pt}{4.185\theta} - Wc = K \quad \ldots\ldots\ldots(1)$$

where:

P = average energy input in watts,
θ = temperature increase in degrees Centigrade,
W = weight of carbon tetrachloride in grams,
c = specific heat of carbon tetrachloride in gram-calories per gram per degree Centigrade,
K = calorimeter constant in gram-calories per degree Centigrade, and
t = time in seconds.

The factor 4.185 is a probable value of the electrical equivalent of heat in International joules per calorie.[8]

Measuring Specific Heat of a Sample:

The specimen whose specific heat is to be measured should be in the form of a powder passing a No. 40 or finer. (It is

$$\frac{\dfrac{Pt}{4.185\theta} - (Wc + K)}{S} = C_s \quad \ldots\ldots(2)$$

where the terms c and K common to the calibration-calculation Eq. 1 are the same, and where P, t, θ, and W have values specific for a determination in which

C_s = specific heat of sample in gram-calories per gram per degree Centigrade, and
S = weight of sample in grams.

Results

Calorimeter Constant:

The calorimeter was calibrated using carbon tetrachloride, whose specific heat of 0.200 g.-cal. per g. per deg. Cent. is taken as the average of the value of 0.201 from Lange[9] and 0.199 to 0.200 from the International Critical Tables[10]

[8] Lange Handbook, Sixth Edition, p. 1710 (1946).
[9] Lange Handbook, Sixth Edition, p. 1483 (1946).
[10] International Critical Tables, First Edition, Vol. 5, p. 107 (1929).

at ordinary room temperatures. The procedure was as previously described, and values of calorimeter constant were calculated from Eq. 1. Three determinations on two different days gave figures of 26.5, 26.4, and 26.6 g.-cal. per deg. Cent. The reproducibility is satisfactory for the purpose of this work.

Determination on Standard Material:

In order to check the accuracy of determination, a suitable standard material whose specific heat was accurately known was sought. It should be available in powder form, be nonhygroscopic, be insoluble in the contact media being employed, and have a moderately low specific gravity.

Ginnings and Corruccini[11] have made extensive studies on pure aluminum oxide, and have concluded that it would be an excellent material for such a standard. They determined its specific heat accurately over a wide temperature range, and found it to have a value of 0.1868 g.-cal. per g. per deg. Cent. (by interpolation) at 27.5 C., the average temperature at which determinations in this work were made.

Two runs using this standard, with carbon tetrachloride as the contact medium, yielded values of 0.187 and 0.187. While these are in excellent agreement with the value derived from Ginnings' and Corruccini's work, the curves from which θ were computed indicated that temperature equilibrium was being reached quite slowly following the heating period, requiring excessive extrapolation of the straight line portion of the cooling curve. Figure 5 is a plot of the data from one of these runs and shows clearly the time lag in the transfer of heat uniformly to the sample.

Suspecting that the density of Al_2O_3 (about 4.0) was enough greater than that of carbon tetrachloride (about 1.6) so that poor agitation was resulting, a contact liquid of higher density was tried. Bromoform (sp. gr. 2.9) seemed promising, although the quantity on hand was not great enough to fill the calorimeter sufficiently. Carbon tetrachloride was mixed with the bromoform until the volume was great enough for a determination. The specific heat of this mixture was then determined, using the calorimeter constant previously established. Values of 0.134, 0.133, and 0.134 g.-cal. per g. per deg. Cent. were obtained.

Using an average figure of 0.134 for the specific heat of the contact medium, two more determinations on Al_2O_3 were made, giving values of 0.187 and 0.185. In these cases the steady-state curves exhibited no signs of excessive time lag in reaching equilbrium, and approximated very closely the shape of those shown in Fig. 4.

Discussion

Choice of Contact Medium:

Considerable experimenting was carried out in attempting to decide what liquid would be suitable for a contact medium. Water was an obvious first choice but suffered from having a very high specific heat of its own and in failing to wet most of the plastic materials on which specific heat data were desired. In addition, its specific gravity was quite low relative to many of these materials, leading to poor agitation of the sample with the adverse effects indicated.

Carbon tetrachloride was finally selected because of its greater density, its good wetting characteristics, low specific heat, and the fact that the latter value is well known, making it possible to calibrate the calorimeter with the same liquid. As shown above, the calorimeter may be used to determine the specific heat of other liquids, which may serve as contact media where other characteristics such as density may make them more desirable.

Evaporation Loss:

With volatile liquids such as carbon tetrachloride, appreciable evaporation may take place during a run. The loss in weight (usually amounting to about one gram) was corrected for by weighing the calorimeter after each run as well as before. The calculated average weight of contact medium was then used in computing results.

The rate of heat loss due to the latent heat of evaporation of the liquid was assumed constant throughout each half of a run and is compensated for in the plot of the steady-state curves. Actually, the rate may increase slightly during the period the heater is on, but the difference is considered negligible.

External Resistance:

Originally the electrical circuit for the calorimeter provided only a single switch between the battery and heating coil. It was soon found that an initial surge took place when the switch was turned on, this being followed by a gradually changing rate of energy input for a period of 30 sec. or more, making any accurate determination of the average energy consumption impossible. An external coil of exactly the same ohmic resistance as the heater was therefore introduced, and switched on about a minute before the calorimeter was supplied energy. This allowed time for a steady state to develop in the electrical circuit so that, during the heating period, the wattage drop (if any) was linear. A much better estimation of the average energy consumption was thus made possible.

Determinations at Other than Room Temperature:

While studies of this nature have not yet been made with the apparatus described, it would seem quite feasible to thermostat the calorimeter and make determinations either above or below room temperature, the range being limited only by the characteristics of the calorimeter materials and contact media and the technical and practical aspects of temperature control.

General:

While the values for calorimeter constant and specific heat of contact medium and standard material are not selected in the sense that "good" values were presented and "poor" were discarded, all from the same series, much data have preceded which were not at all comparable in precision or accuracy. One of the major factors in making possible results of the precision indicated above has been the careful control of many variables, so that they are reproducible and can be compensated for in calibration of the instrument and plotting of temperature data.

Further work is planned in evaluating the ultimate precision of the method and in investigating the conditions necessary to handle a wide variety of materials. The figures presented merely demonstrate a good probability that the equipment and techniques will have definite value in determining specific heat with sufficient accuracy for design purposes.

Conclusions

A simple, inexpensive, and easily operated calorimeter for the measurement of specific heat of powdered solids, particularly plastics, has been described. It is also adapted to the measurement of the heat capacity of liquids. It permits a determination with an accuracy of approximately one per cent in a period of about twenty minutes.

Acknowledgment:

The author acknowledges the contribution of K. B. Goldblum of the Plastics Laboratory in originally devising and using an apparatus upon which the present one is based, and extends appreciation to Mrs. D. M. Walker, also of the Plastics Laboratory, for making many of the determinations during the process of evolution of this equipment.

[11] D. C. Ginnings and R. J. Corruccini, "Enthalpy, Specific Heat and Entropy of Aluminum Oxide from 0 to 900 C.," *Journal of Research*, Nat. Bur. Stds., Vol. 38, June, 1947, p. 593 (*RP* 1797).

Apparatus for Automatic Uniform Controlled Rise of Temperature

By V. C. Taxwood[1] and C. R. Stock[1]

A NUMBER of laboratory procedures involving thermal considerations require an increase in temperature at a uniform controlled rate. Examples of these are the heat distortion test for plastics[2] and the ring-and-ball softening point test for resins and pitches.[3] Manual control is usually expensive of operator's time and generally affords unsatisfactory control because the temperature necessarily is corrected only after a noticeable error has occurred. The particular problem of raising the temperature uniformly at a predetermined rate in a small tank of oil was overcome in this laboratory by devising a simple and inexpensive method of automatic control.

Several other devices that employ automatic control have been developed by others. The American Instrument Co.[4] advertise an instrument for measuring the heat distortion of plastics wherein the contact of a bimetallic thermostat is moved at a constant rate by a synchronous motor, thus automatically controlling the rate of temperature rise. Heirholzer and Boyer, in an article describing some thermal deformation properties of plastics,[5] have also mentioned briefly their use of a control system substantially identical to that described in more detail in the following article.

The rate of heat transfer, dQ/dt, between an object and its surroundings is known from Newton's law of cooling,

$$dQ/dt = -k\theta \qquad (1)$$

to depend on the temperature differential, θ, and the thermal diffusion coefficient, k (radiation and second order effects neglected). Hence, with a constant power input, the rate of change in temperature of the object will decrease toward a limiting temperature at which the loss equals the input. On a given time and temperature scale, this exponential relationship will exhibit less curvature as the thermal diffusion is reduced by improving the insulation. For any insulation, however, to obtain a certain rate of change in temperature the power supplied to the object must change according to

$$P = C\frac{d\theta}{dt} + k\theta \qquad (2)$$

where P is the power required to give a rate of change of temperature difference, $d\theta/dt$, to an object with heat capacity, C.

For electrical heating, the power derived from commercial resistance heaters is proportional to the square of the potential (or current) as long as the thermal coefficient of resistance can be neglected. Strictly speaking, a constant rate of change of input power, and hence of temperature, therefore requires that the potential change as the square root of the elapsed time. For most customary electrical control devices this would require the slight added complication of an interposed cam between the control and any automatic drive such as a motor. A good approximation to a uniform temperature rise over a limited range has been obtained, however, with linear increase in potential, possibly because of the compensating effect of increased radiation loss as the temperature increases. The need for cam operation is thus eliminated in favor of a conventional drive; it remains only to select the proper driving speed to obtain the desired rate of rise in temperature.

Construction and Experimental Method

As a container for the heat distortion test for plastics, a metal tank, 9 by 5 by 7 in. was insulated with 1.5 in. of 85 per cent magnesia block on four sides and the bottom. This was in turn enclosed with a light metal box and an insulating cover. This insulation made it possible to keep power requirements low, with consequently smaller control parts and heater.

To determine the minimum size of immersion heater required to obtain the desired rate of rise at the maximum

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[2] Tentative Method of Test for Heat Distortion Temperature of Plastics (D 648 – 45 T), 1946 Book of A.S.T.M. Standards, Part III-B, p. 872.

[3] Tentative Method of Test for Softening Point (Ball and Shoulder Ring Apparatus) (E 28 – 42 T), 1946 Book of A.S.T.M. Standards, Part III-B, p. 1303.

[4] Catalog No. 10-200, American Instrument Co., Silver Spring, Md.

[5] G. A. Heirholzer and R. F. Boyer, "An Automatic Heat Distortion Recorder for Plastics," ASTM BULLETIN, No. 134, May, 1945, p. 37.

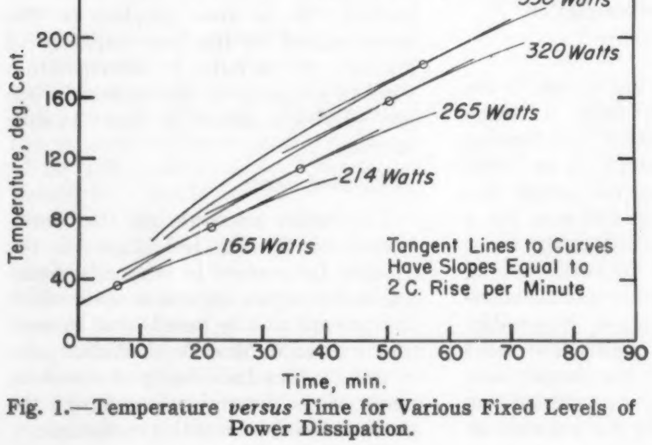

Fig. 1.—Temperature *versus* Time for Various Fixed Levels of Power Dissipation.

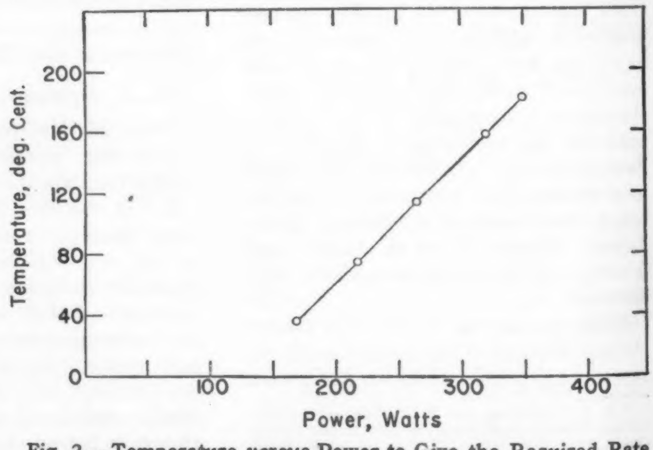

Fig. 2.—Temperature *versus* Power to Give the Required Rate of Rise (2 C. per Min.)

anticipated temperature, several trials were made with an available heater at various fixed levels of power dissipation (Fig. 1), and these were plotted against the corresponding temperatures at which the minimum required rate of rise (2 C. per min.) took place (Fig. 2). As a result, a rod-type heater[6] rated at 330 watts at 115 v. was found adequate up to about 180 C.

A variable autotransformer[7] was selected to regulate the potential applied across the heater. To calculate the rate at which its shaft should be rotated, the following data were used:

1. Increasing the temperature uniformly from 25 C., to 200 C., at 2 C. per min. requires 87.5 min.
2. The potential must rise in the same period from 77.5 to 118 v., if assumptions are correct.
3. The corresponding rotation of the transformer shaft was found to be 95.2 deg.; the angular velocity is therefore 65.3 deg. per hr., or 0.18 rph.

A small clock-type synchronous motor with an angular velocity of 1 rph. was chosen to drive the transformer by means of a chain and sprocket giving a speed reduction of 5:1 or 0.2 rph. The resulting rate of temperature rise was nearly linear, as may be observed in Fig. 3 for data plotted from a trial operation of the equipment. Minor adjustments in the rate can be made by a rheostat of low resistance in series with the heater.

A friction clutch release permits resetting the transformer after each run.

Conclusions

The apparatus has been used successfully for several years as part of an instrument for determining the heat distortion temperature of plastics[5] according to A.S.T.M. specification. With proper choice of variable autotransformer, heaters, suitable insulation, and rate of drive, a wide range of requirements should be encompassed by this type of control. For example, it should be possible thus to control electric annealing furnaces.

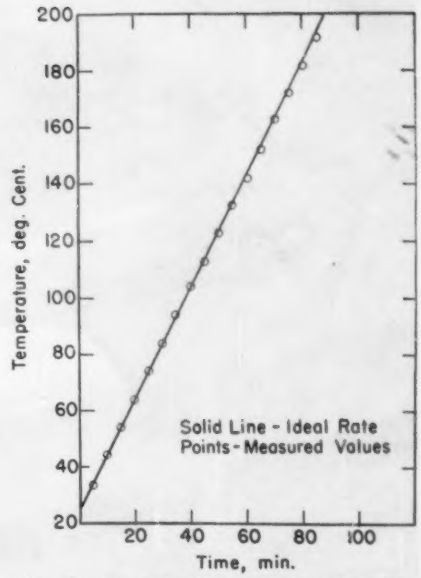

Fig. 3.—Temperature *versus* Time for Ideal and Measured Rates of Temperature Rise.

[6] Chromalox, Type TS-2024, with flanges for full immersion.
[7] Powerstat, 3.0 amp.

Simplified Preparation of Flat Specimens for Tensile Strength Tests

By V. C. Taxwood[1]

The procedure of machining large quantities of flat strips to the dimensional requirements for A.S.T.M. tension tests of certain metals and nonmetals[2,3,4] can be time consuming and tedious if carried out on the conventional miller or shaper. However, Templin[5] has described a milling machine in which special cutters machine flat metal tension specimens perpendicular to the direction of stress application. Although Templin's work has shown that machining marks in this direction have no harmful effects on metal specimens, it is known to be detrimental for many plastics materials. Machining parallel to the application of stress substantially eliminates this effect. Moreover, the operation of forming the central section of reduced width will, for some materials, rapidly dull carbon-steel cutters and, in a few instances even tungsten-carbide tips. In the field of plastics, glass cloth laminates with melamine formaldehyde resin are known for this tendency of dulling tools rapidly and require a regular sharpening schedule.

Another deficiency occasionally evident in milling plastics specimens is the tendency, on the one hand, for some thermoset moldings and castings to chip and, on the other hand, for thermoplastics to soften and flow on the machined surfaces as a result of the heat generated. Both tendencies impair the suitability of the specimens for accurate testing.

A technique making use of an abrasive belt for shaping specimens has been found to simplify these problems. The Owens-Corning Fiberglas Corp.[6] has designed a belt sander capable of forming accurately a stack of specimens up to several inches high, starting with rough-cut strips of material. The operation is complete in a few minutes. DeWaard[7] has also reported the modification of a conventional horizontal sander to form plastics; aluminum and brass have also been readily shaped.

The sander described here was developed in lieu of that of the Owens-Corning Fiberglas Corp. for several reasons: first, the versatility of that machine was found not to be required for our work and, second, with this less drastic requirement it was possible to adapt a standard belt sander for the purpose at a considerable saving.

Construction

Various parts of the sander[8] were purchased, including all bearings, pulleys, adjusting mechanism, and main bearing housing. In addition a table top for an 8-in. power saw was obtained from the same company. To enable the drive pulley, over which the sanding belt runs,

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[2] A.S.T.M. Method E 8-46.
[3] A.S.T.M. Method D 229-46.
[4] A.S.T.M. Method D 638-46 T.
[5] R. L. Templin, "Methods for Determining the Tensile Properties of Thin Sheet Metals," *Proceedings*, Am. Soc. Testing Mats., Vol. 27, Part II, p. 235 (1927).
[6] Frank E. Allen, "Machining Glass-reinforced Low-pressure Laminates," *Modern Plastics*, May, 1944, pp. 107–9.
[7] R. D. DeWaard, "An Expedient Method for Preparation of Cantilever Beam Fatigue Specimens," ASTM BULLETIN, No. 141, August, 1946, p. 40.
[8] Delta Mfg. Co. (6-in. Belt Sander).

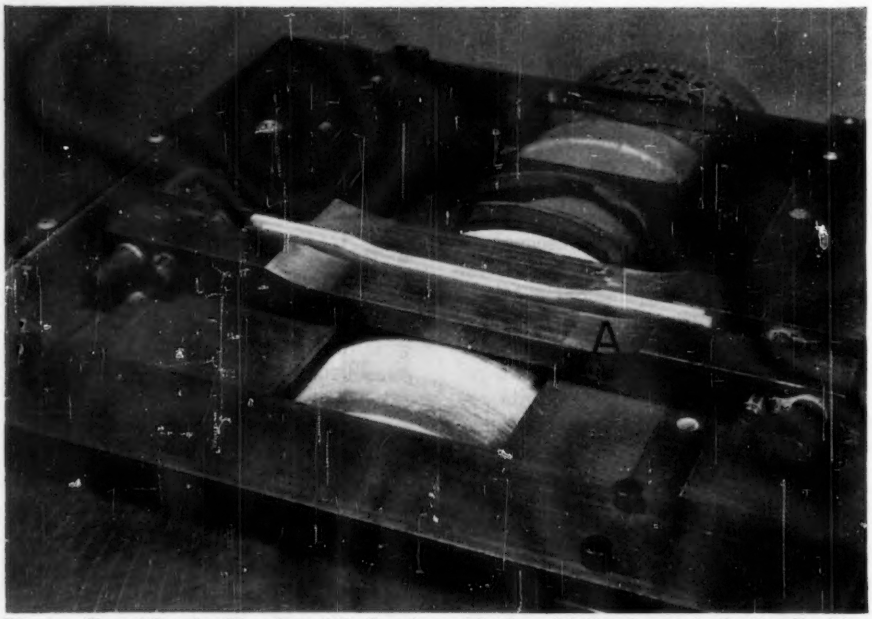

Fig. 1.—Top of Sander Showing: (*A*), Specimen Holder with Specimens in Cutting Position.

to protrude partly through the table top, the top was machined as shown in Fig. 1. The edges of the original opening were beveled at about 45 deg. and a hole was cut to allow the bearing support to protrude through the table. The top is hinged so that the distance that the sanding pulley protrudes can be controlled by an adjusting screw (*A*, Fig. 2).

A metal table (Fig. 3) was constructed to support the motor[9], belt sander, and all necessary components, and an enclosure was built around the belt and connected by a hose to a dust collector.

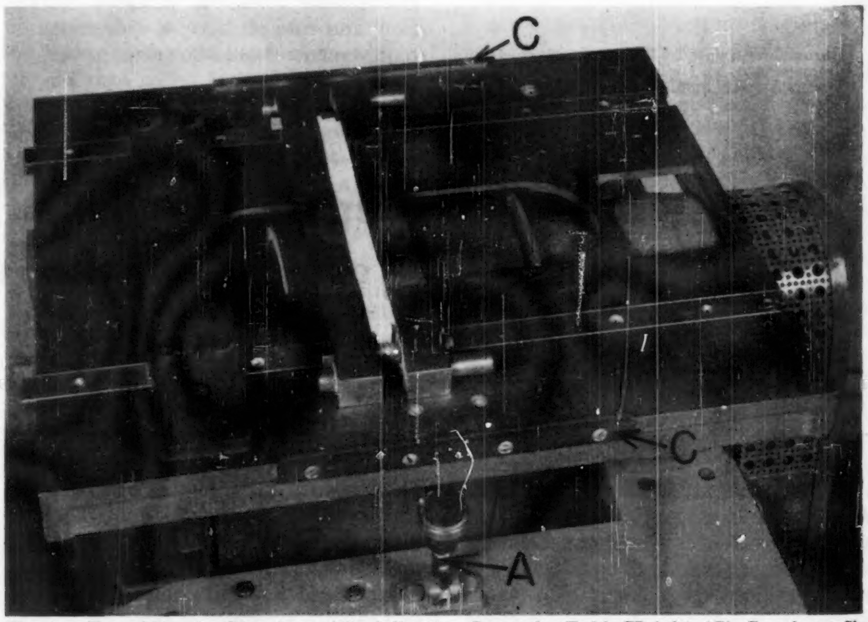

Fig. 2.—Top of Sander Showing: (*A*), Adjusting Screw for Table Height, (*B*), Specimen Jig Guide, and (*C*), Stops to Determine Jig Travel.

Fig. 3.—Sander with Top Raised and Dust Cover Removed to Show Sander Belt, and Pulley Arrangement.

A metal jig was made, into which specimen strips could be clamped while being shaped (*A*, Fig. 1). It is approximately 12 in. long and has the same shape as a tension specimen, but slightly narrower at the test section. It was machined from $\frac{13}{16}$ by 1-in. steel bar stock. A guide for the jig (*B*, Fig. 2) was made to fit the ways in the table and stops were attached (*C*, Fig. 2) to limit the travel of the specimen holder. Figure 3 shows the table raised and dust-collector cover removed to expose the drive pulley, idler pulley, and abrasive belt.

Reducing the width of the sanding belt from 6 in. to 5 in. makes it easier to adjust and align. For general cutting, cloth belts containing 80-grit aluminum oxide have been used successfully.

The diameter of the drive pulley determines the radius of the fillet in the finished specimen. A pulley should be used having a radius that will meet the desired specifications, taking the thickness of the belt into consideration.

The cost of construction consists of material costs and machine shop time. Parts for the sander cost about $50 exclusive of the motor. Machine shop time, including assembling, totaled about 60 hr.

Operation

Tension specimens are sanded from rectangular blanks $8\frac{1}{2}$ by $\frac{3}{4}$ in. From one to eight specimens, depending on the material and thickness, are clamped in the jig and the table height is adjusted for the required depth of cut. With a new belt it has been found that a stack of plastics specimens can be sanded to size in about 2 min. without heating appreciably. For most plastics the belts used are capable of cutting over a hundred specimens $\frac{1}{8}$ in. thick. These figures should also hold approximately for brass and aluminum.

In forming the specimens on the sander, all scratches are parallel to the direction in which stress is to be applied, thus reducing loci of stress concentration. Moreover, no chipping has been observed, even for brittle plastics. Several different types of laminates and clear resin have been cut with excellent finish.

[9] $\frac{1}{4}$ to $\frac{1}{3}$ hp. 1725 rpm. is suitable.

Harold DeWitt Smith Memorial Medal

As a testimonial to the late Dr. Harold DeWitt Smith, in recognition of his lifetime of devotion and his many contributions to the science of utilization of textile fibers, a Harold DeWitt Smith Memorial Medal is to be awarded annually for outstanding achievement in the field. The award will be presented by A.S.T.M. Committee D-13 on Textile Materials.

This testimonial has been made possible through the generosity of Fabric Research Laboratories, Inc., Boston, Mass., who have sponsored the award.

General regulations governing the Award have recently been adopted by mutual agreement between Committee D-13 and Fabric Research Laboratories. The regulations include provision for a Committee of Award to elect the candidate for the award. The Award Committee will be comprised of five individuals as follows: (1) the chairman of Committee D-13, (2) a member of the faculty of an educational institution awarding degrees in science or engineering, (3) a member who is an employee of a concern manufacturing textile fibers or textile structures, (4) a member who is a textile scientist with an established reputation, and (5) a member at large who may be any qualified individual.

Harold DeWitt Smith whose untimely death occurred in Mexico, on February 10, 1947, was widely known for the number, variety, and importance of his contributions to the advancement of the textile industry. He also rendered important service to the Quartermaster General during World War II.

A graduate of Lehigh University in 1920, Harold Smith, having subsequently served five years in a technical capacity with Wellington Sears and Company, completed his scientific education in Germany. In 1930, he received his Ph.D. degree in physical chemistry from the University of Berlin on the basis of his research at the Kaiser Wilhelm Institut under Dr. R. O. Herzog.

Early in his career, he developed an intense interest in the physical properties of fibers and fabrics. His published papers reveal a great versatility embracing many fields of chemistry and physics. In addition, he was known as an able lecturer. In 1947, he was honored by A.S.T.M. through his selection to give the Edgar Marburg Lecture. Entitled "Textile Fibers—An Engineering Approach to Their Properties and Uses," the lecture is considered one of the classics in the field of textiles. It represents an original approach to the subject and is widely used as reference material.

Dr. Smith was a member of and active in many scientific and technical societies and was one of the original group forming the Textile Research Council which eventually became the Textile Research Institute. He took an active part in the growth and development of that Institute and served as nonpaid President in 1945.

At the time of his death, Dr. Smith was Treasurer of A. M. Tenney Associates; he was associated with Ashton M. Tenney in that firm from its organization in 1930.

In addition to serving as a testimonial to Harold DeWitt Smith in recognition of his many years of unselfish devotion to the interests of the textile industry, this award is intended to encourage and to afford public recognition of outstanding achievement in, or contribution to the science of utilization of fibers.

Committe of Award

The selection of the first Committee of Award has been announced, the membership being as follows:

H. J. Ball, Chairman, Lowell Textile Institute
A. G. Ashcroft, Alexander Smith & Sons Carpet Co.
K. T. Hertel, University of Tennessee
G. H. Hotte, A. M. Tenney Associates, Inc.
A. G. Scroggie, E. I. du Pont de Nemours & Co., Inc.
W. H. Whitcomb, Secretary

Refractories Studied by Graduate Ceramic Students at Universities.

In the interest of furthering the training of technologists for the refractories industry, the American Refractories Institute has sponsored fellowships for worthy graduate students who are interested in the study of problems relating to refractory materials. Eight fellowships on refractories have been established at universities having ceramic departments, and a brief outline of the work which has been completed or is in progress is presented.

1. Richard L. Allen, of the Research Foundation at The Ohio State University, is investigating the influence of very high forming pressures on the porosity, density, and strength of refractory compositions containing high percentages of coarse nonplastic materials.
2. Henry C. Brassfield, at the Missouri School of Mines and Metallurgy, is studying the behavior of titanium dioxide on silica brick during burning, as a catalyzer, to convert quartz to cristobalite and tridymite. X-ray spectrometer data on fired samples, as well as those obtained during heating, are to be used to evaluate the extent of the conversion.
3. William E. Brown, in the School of Ceramics at Rutgers University, is engaged in learning of the part played by alkalies on the refractoriness of siliceous fireclay brick. Use is to be made of the hot load test to study the effect of these fluxes when added to alkali-free mixes.
4. William D. Fitzpatrick, in the Ceramic Engineering Department of the University of Illinois, is conducting an investigation on some of the effects of the glass phase present in certain refractory compositions.
5. J. Raymond Hensler, in the Division of Ceramics at The Pennsylvania State College, has been engaged in the study of electrical resistance of refractories at elevated temperatures. Later he expects to measure this property, up to practical temperature limitations, on commercial and laboratory-prepared refractories, the maximum temperature of the equipment to be of the order of 3600 F.
6. William D. Kingery, of Massachusetts Institute of Technology, is investigating certain orthophosphate cements for use in refractory compositions by studying the mechanism of setting, their bonding properties, and the effect of heat on their stability. Later, an attempt will be made to correlate the setting action with atomic structure.
7. Robert A. Morgan has studied in the Division of Ceramics at The Pennsylvania State College certain phase relations of the system beryllia-alumina-silica which are of interest to ceramists and metallurgists, the results of which are being prepared for publication.
8. Hugh H. Wilson, Jr., in the Department of Engineering Research of North Carolina State College, is determining the hot load-bearing characteristics of silica-clay refractory compositions made from selected raw materials prepared with controlled grain sizes.

Microbiological Deterioration of Organic Materials

This 46-page booklet, published by the National Bureau of Standards, includes a careful review of the literature on microbiological deterioration of organic materials and presents the results of investigation of the application and usefulness of the various microbiological tests. The objective and authoritative nature of this publication commend it to all who are interested in its subject. Copies are available at twenty-five cents each from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

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PROFESSIONAL CARDS

On this page are announcements by leading organizations and individuals of their services.